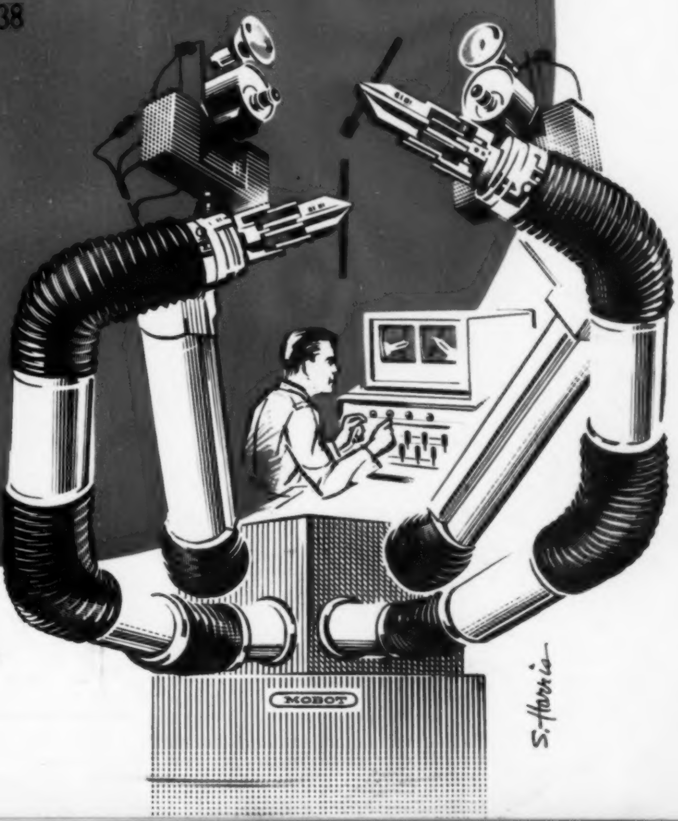
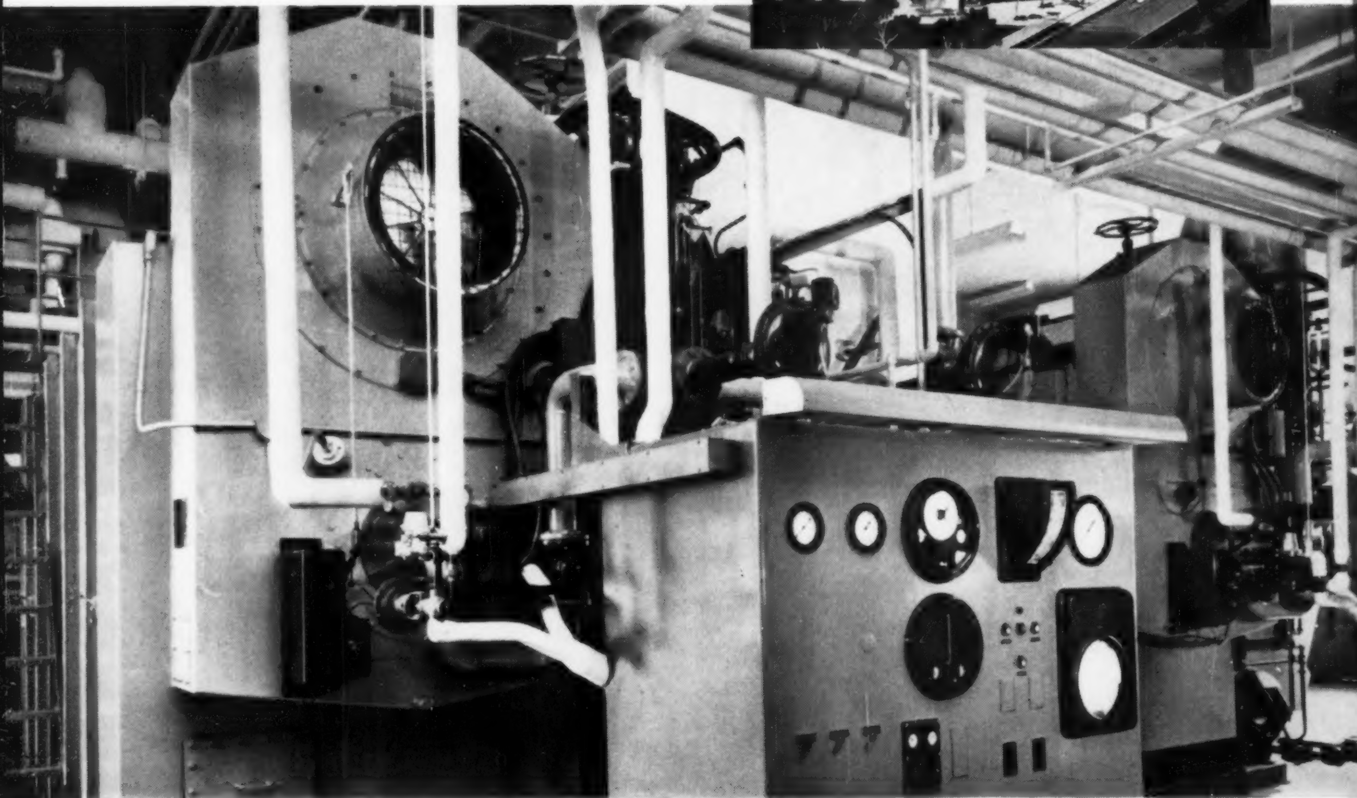
MECHANICAL ENGINEERING

February 1961



Robot with Television Eyes

℞ For Steam at Holy Cross Hospital



Two new oil and gas-fired B&W Package Units dependably meet crucial 40,000-lb-per-hour steam requirement at well known Chicago hospital

Day after day, year after year, each and every hospital activity is vital. This continuous, reliable hospital service must, of course, be supported by absolute dependability in equipment.

That's why so many institutions such as Chicago's Holy Cross Hospital have selected B&W Package Boilers to meet their steam requirements. Supplying clean, dry steam for critical uses such as heating, laundry, kitchens and sterilizers, B&W Package Boilers have become a standard of dependability in hospitals and other institutions throughout the nation.

Dependability, however, is only part of the story. Budget-minded hospital management has found the low maintenance, cleanliness of operation, high operating economies, flexibility, rapid response to demand, and maximum capacity in minimum space afforded by B&W shop-assembled units equally attractive features. What's more, they appreciate the assurance that at any time during the life of the boiler, even 20 or 30 years hence, B&W's nationwide service organization will be promptly and economically available if needed.

Serving the myriad steam requirements of a vital installation like Chicago's Holy Cross Hospital is further evidence in action of dependable steam generation by B&W. Whatever *your* steam requirements... whatever your most economical fuel... B&W has the boiler best suited to your application. Your local B&W representative has all the facts on your area. Please call him soon. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W — THE NATION'S LEADING MANUFACTURER OF INDUSTRIAL BOILERS

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-981A-1B

MECHANICAL ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

Contents

VOLUME 83 • NUMBER 2 • FEBRUARY, 1961

THE COVER

Featuring the visual charm of two hungry boa constrictors, the arms of this remote-controlled handling mechanism each bear a television camera for remote control. Hughes Aircraft Company of Culver City, Calif., designed the mobile robot for hot areas not safe for a man. The machine, designated Mobot Mark II, has three joints in each arm, and is strong enough to lift a lead brick, and delicate enough to replace a light bulb. Its soft touch stems from inflated pads on its hands in which the pressure can be controlled by the operator.

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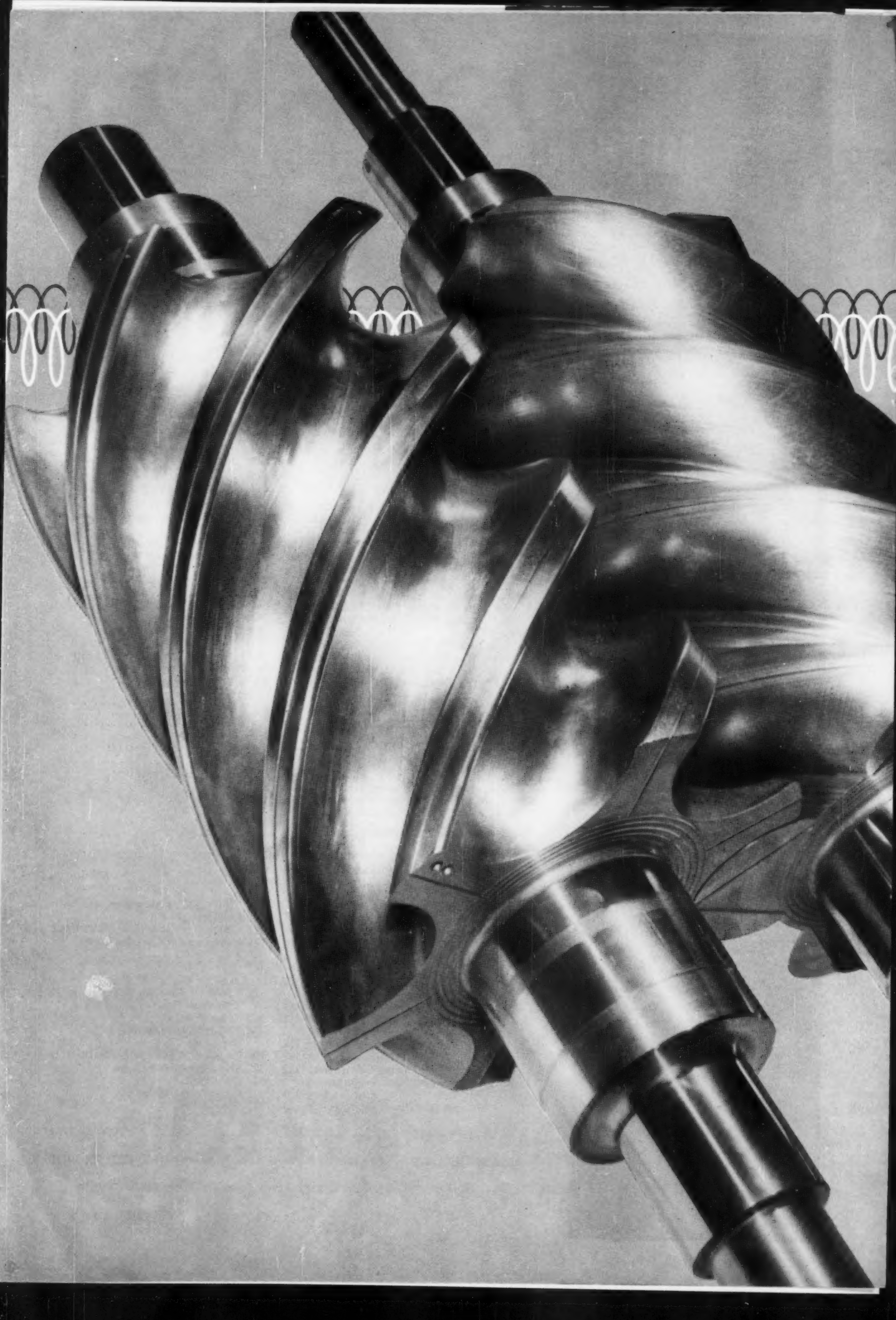


PNEUMATIC transmitting tachometer with

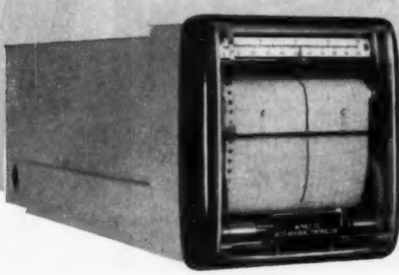
DIRECT LINEAR SIGNAL

the Foxboro Type 16A Pneumatic Speed Transmitter

- **Mounts in ANY position**
- **Accurate to ±½% across entire range**
- **Needs no lubrication**
- **Dust-tight gasketed case continuously purged**
- **Simple force-balance mechanical principle.**

Direct-connects to remote pneumatic recorder or controller, such as Consotrol* panel recorder shown below.

****Reg. U.S. Pat. Off.***



Here's a tachometer with 3-15 psi air signal *directly proportional* to rpm! Speed changes are recorded on a uniform-scale chart. Accurate measurements of rpm are easy to read throughout the entire range. No crowded bottom scale!

The Type 16A Speed Transmitter will measure *any* desired range. (An optional integral speed changer is available for ranges from 0-600 rpm to 0-6500 rpm). Full-scale accuracy of ±½% is consistently maintained. Small and light weight, it can be mounted *in any position* — never needs lubrication.

For rotating equipment having wide speed variations, the Type 16A is ideal. It's available for either clockwise or counter-clockwise rotation, and can easily be incorporated into any present pneumatic control system. Write for full details. **The Foxboro Company, 962 Neponset Ave., Foxboro, Massachusetts, U.S.A.**

FOXBORO

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PNEUMATIC SPEED TRANSMITTERS

FALK

A GOOD NAME IN INDUSTRY

FALK STEELFLEX COUPLINGS
for industrial applications...large or small

Giant Falk Coupling smooths out steel blooming mill performance

On a blooming mill at the Copperweld Steel Company plant in Warren, Ohio, installation of a large Falk Steelflex coupling between motor and pinion stand eliminated troublesome noise and vibration which threatened to damage mill machinery. Transmitting 5,000 hp at 50/100 rpm, this is not the largest Falk coupling... others are designed to transmit up to 130,000 hp at 100 rpm.

This installation and others like it prove the Falk concept of shaft coupling design—namely, a modern shaft coupling must contribute to the successful performance of the machinery system.

What does this mean to you? Just this: On large machines as well as small, the exclusive Falk grid-groove design does make a difference, and the difference is torsional resiliency with the strength of steel...reason enough to specify Falk Steelflex couplings as "long life" insurance for your connected machinery.

Falk Steelflex couplings are available in standard designs in 34 sizes for applications from .3 hp at 100 rpm to 130,000 hp at 100 rpm, with excellent delivery. Write for Bulletin 4100.

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MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS
Representatives and Distributors in most principal cities

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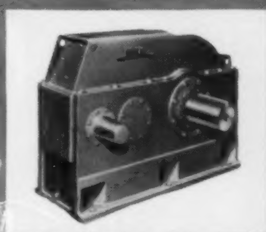
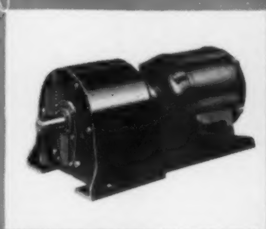
A Point to Ponder... When you need gear drives or shaft couplings of "FALK OR EQUAL" quality, where but from Falk can you get the "OR EQUAL"?

Other members of America's First Family of Power Transmission Products



SPEED REDUCERS
Parallel Shaft up to 3500 hp. Ask for Bulletin 1100. Also Right Angle and Concentric Shaft designs.



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—up to 75 hp. Horizontal, Vertical, and Right Angle. All-Motor and Integral Types. Ask for Bulletin 3100.

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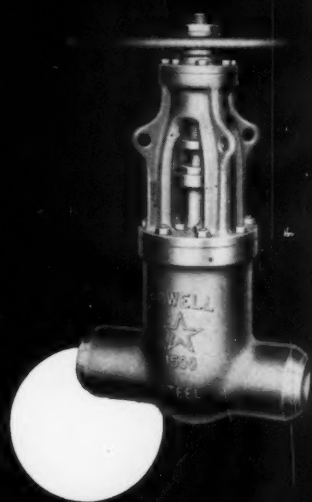
POWELLFUL PERFORMANCE!

Powell pressure seal valves have been proved to control high temperatures and pressures in modern industries. More than 10,000 Powell pressure seal valves in installations on many continents have proved themselves to be precision-built, precision-tested, precision-performing.

This is just another example of Powell's unfailing quality as leading industrial valve supplier of the world. Let Powell's 115 years of valve manufacturing experience go to work for you.

So always look to Powell to solve your valve problems and fill your valve needs. Talk to the Powell valve distributor in your city. Or contact The Wm. Powell Company—TODAY!

600-pound Steel Pressure Seal "Y" Globe Valve—Fig. 16031 W.E. Pressure Seal Steel Globe Valves are also available for 900 and 1500 pounds pressure.



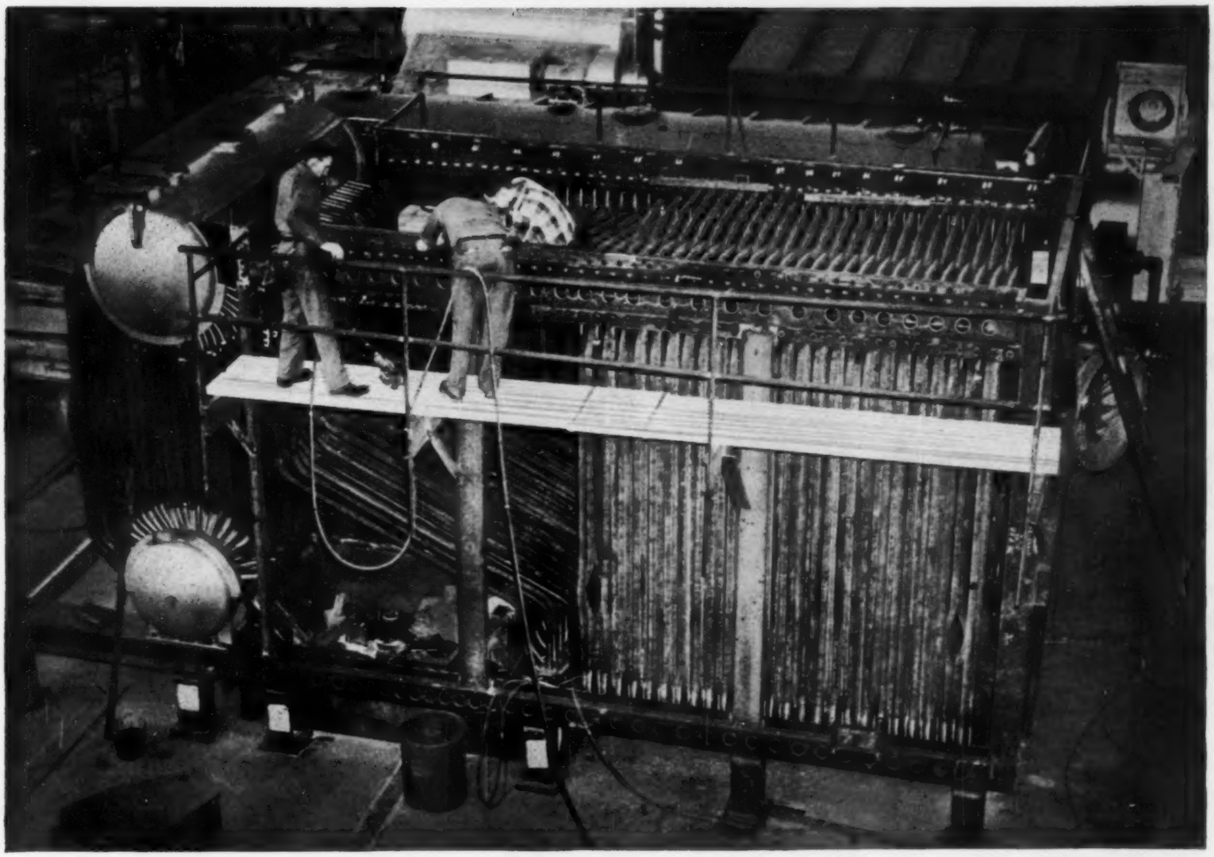
1500-pound Steel Pressure Seal Gate Valve—Fig. 11303 W.E. 600, 900, and 2500 pound pressure seal gate valves can also be furnished.

1500-pound Steel Pressure Seal Horizontal Lift Check Valve—Fig. 11365 W.E. Also available for 900 pounds. This design assures maximum flow through with minimum pressure drop and turbulence.

115th year of manufacturing industrial valves for the free world

POWELL PRESSURE SEAL **VALVES**

THE WM. POWELL COMPANY CINCINNATI 22, OHIO



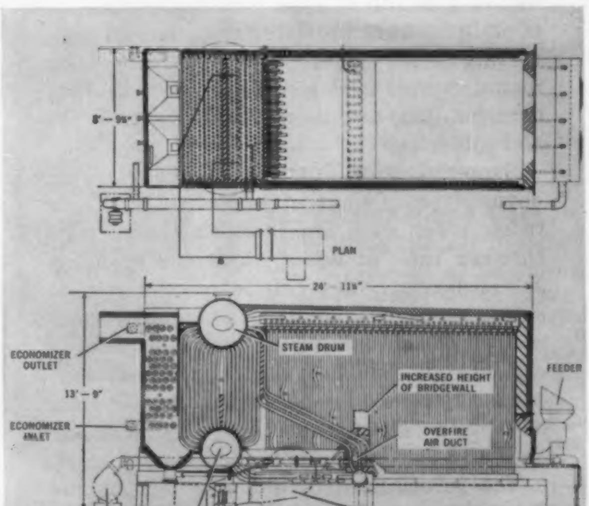
Stoker-fired boiler being shop assembled.

Coal fuels this push-button packaged steam generator

Good news for industry in areas where coal is economical —FW stoker-fired *packaged* steam generators that are comparable with the most advanced gas and oil fired units. Engineered and built with precision, the design has been thoroughly proved and tested in more than two years of operation at full design capacity and above. Performance has been consistently better than expected under all operating conditions.

Units designed for semi-automatic operation are available in three standard sizes: 43,000, 50,000 and 63,000 lb/hr steam capacity at pressures to 250 psig. Push-button control brings these units on or off banked fire. They may be converted to oil firing in a matter of hours. And for easy handling and speedy low-cost erection, they are shipped in three major subassemblies, one of which is the complete boiler and economizer section shown above and at right.

For complete performance and descriptive data on FW stoker-fired packaged steam generators, request bulletin PG59-4. Standard oil and gas fired units are also available in capacities from 13,000 to 100,000 lb/hr. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.



Heat Engineered products, plants and processes . . . for the world's industrial progress.

FOSTER FW WHEELER

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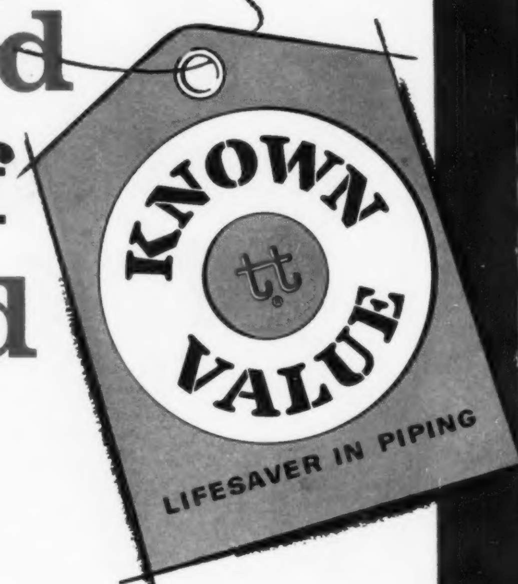
Be sure of this standard to be sure of the standard you specify



The TUBE-TURN trademark is more than a *trade* mark. It identifies a *standard* of performance and satisfaction. It has universal recognition and acceptance as a mark of *known* value.

TUBE-TURN components for welded piping systems are the product of decades of pioneering, of a wealth of experience without equal, of an investment in related research and engineering exceeding that made by all other such manufacturers *combined*. These are important considerations in this era of widespread deceit and subterfuge.

Simply copying TUBE-TURN products is an obviously easy shortcut to look-alike substitutes. When such impostors sneak into jobs through the "or equal" loophole in many specifications, however, it is impossible to be sure they meet TUBE-TURN standards. Only costly and time-consuming laboratory testing can prove it. And such testing, if undertaken, cannot be conclusive because the proper tests destroy the samples and there is never assurance of uniformity in any quantity delivered.

The substitution of *anything* for genuine TUBE-TURN welding fittings and flanges is difficult to understand or justify. TUBE-TURN quality demands no premium. TUBE-TURN products are always priced competitively with truly comparable items. Any so-called "bargain" substitutes *must* be substandard in value! What "saving" can possibly justify the risk involved when a single failure may easily result in losses greater than the cost of the entire piping installation?

Inferior Substitutes Can be Avoided!

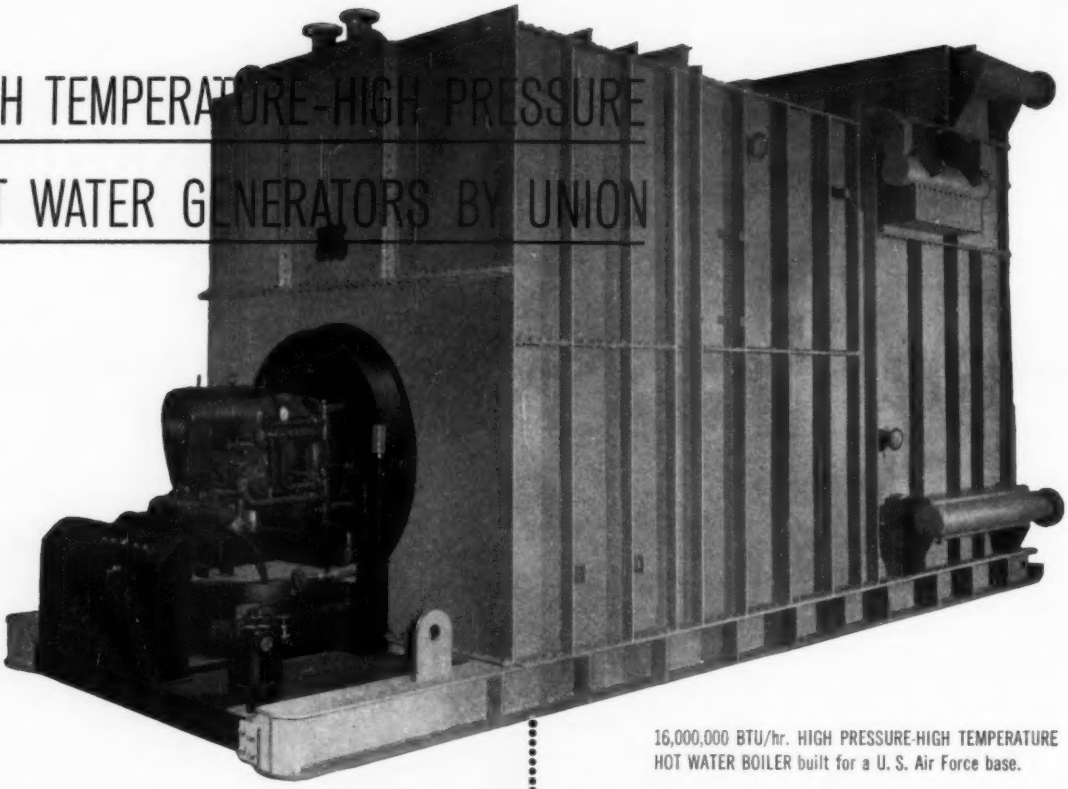
Specifications calling for TUBE-TURN products with the customary "or equal" wording need not be the open door to risk or trouble. Responsible suppliers and contractors will not only serve you honestly and properly, they will be glad to provide proof of it. They will give you an affidavit that they have met your specifications to the letter . . . and they will identify and describe whatever substitutes they elected to supply within the "or equal" latitude allowed. This is a sensible procedure for everyone concerned. Write us today for a copy of Bulletin 1031-A205 on this subject. TUBE TURNS, Louisville 1, Kentucky.

"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS

Division of CHEMETRON *Corporation*

HIGH TEMPERATURE-HIGH PRESSURE HOT WATER GENERATORS BY UNION



16,000,000 BTU/hr. HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER built for a U. S. Air Force base.

SHOP ASSEMBLED UNITS INSTALLED WITHOUT COSTLY FIELD BALANCING

Right from the start, you can save with a Union shop assembled HTHP Hot Water Generator. With all of its circuits of the same hydraulic length, time consuming field balancing can be eliminated. Most units do not require orifices or any other mechanical adjustments to equalize flow at the time of installation.

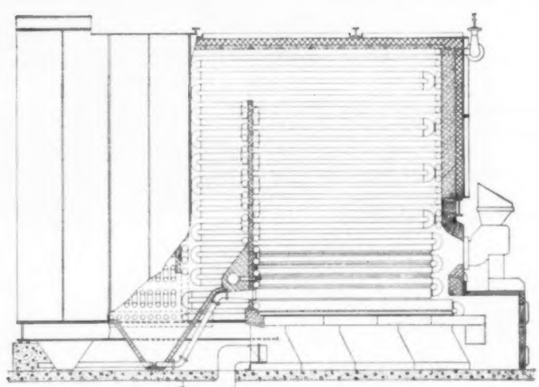
High water velocities (above 5 ft./sec.) and liberally proportioned, water cooled furnaces eliminate localized overheating. As there are no multi-tube circuits in the radiant section, recirculation within a circuit is impossible, thereby eliminating vapor binding or stagnant flow areas.

Liquid and gas flow run counter to each other. With the liquid inlet positioned at the top of the convection section, the lowest temperature liquid is served by the lowest temperature gas. As a result, generator efficiency is improved and the risk of thermal shock minimized.

Standard units (both shop assembled and field erected) can be modified to meet a wide range of job requirements. They can be arranged for firing with most commercial fuels as well as waste fuels in liquid, gaseous or solid form.

For specific information, outline your requirements to a Union representative or contact Union Iron Works.

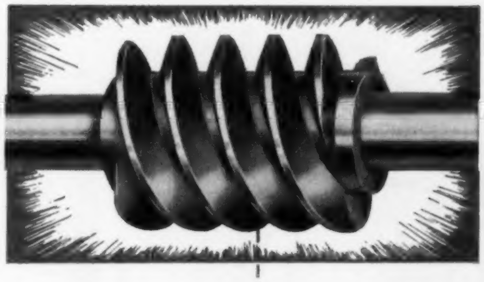
UNION IRON WORKS · ERIE, PENNSYLVANIA
DIVISION OF RILEY STOKER CORP.

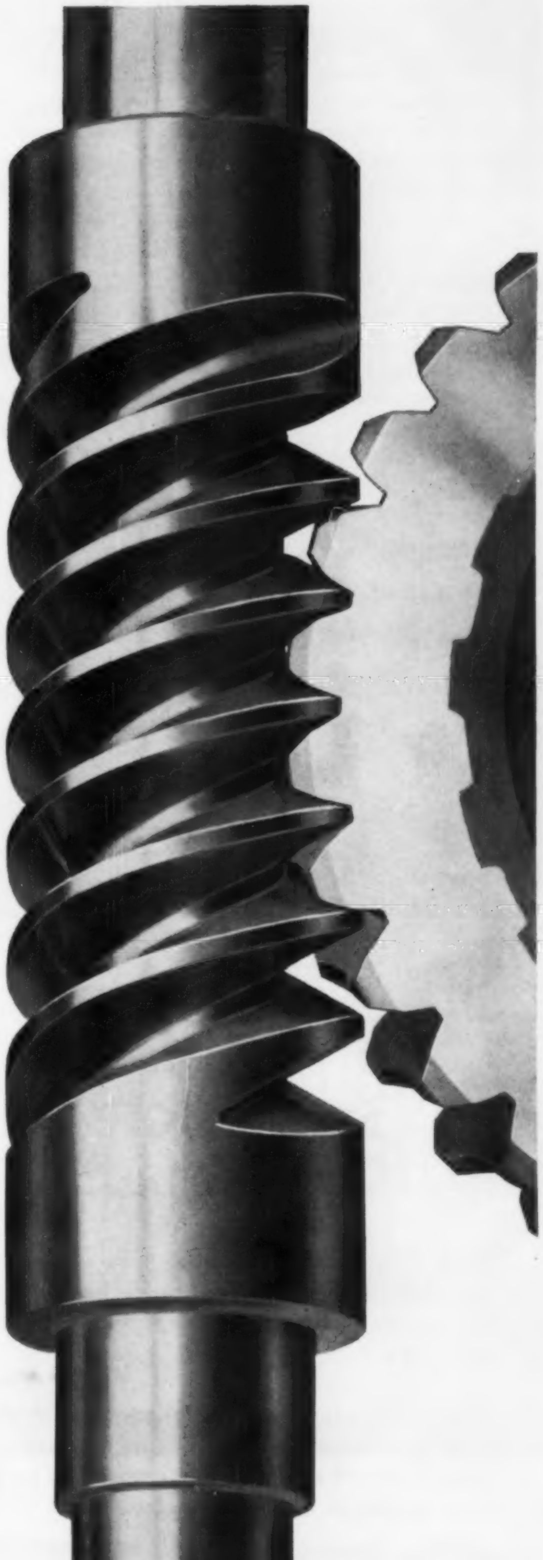


31,000,000 BTU/hr. FORCED CIRCULATION, HIGH PRESSURE-HIGH TEMPERATURE HOT WATER BOILER. Equipped for firing by an oscillating grate spreader stoker with fly ash reinjection. Fully factory-assembled for shipment.

UNION

water tube steam generators and allied equipment





new nuclear plants choose

FULFILLS THE EXACTING
HEAT EXCHANGERS

Centrifugal stainless steel castings readied for shipment by U.S. Pipe

The Government's new SPERT III nuclear plant at the National Reactor Station near Idaho Falls, Idaho, operating since December, 1958 to study nuclear reactor safety, uses U.S. Pipe's centrifugally cast stainless steel pipe for its coolant system.

SPERT III is classified as a high pressure, high temperature, light water moderated and cooled reactor. Its versatility permits transient tests under various initial conditions of pressure, temperature, and coolant flow. For example, pressures ranging from atmospheric to 2,500 psi and water temperatures from 68° to 668° F.

Another new nuclear power plant, engineered and constructed by Stone & Webster for Yankee Atomic Electric Company, is using centrifugally cast stainless steel heat exchanger shells made by U.S. Pipe and fabricated by the Southwestern Engineering Company in Los Angeles, Calif.

Stainless steel, centrifugally cast, made to rigid specifications, may be the answer to your piping or heat exchanger problem. For more information, write or call:

Bundy can mass-fabricate practically anything

Your most complex tubing designs are turned into tight tolerance components at Bundy. It's done with Bundyweld®, the tubing for design engineers with special problems. In addition to cutting, burring, flaring and bending, Bundy can expand, swage, flatten, upset, coil, bifurcate or machine this tubing to your specifications. In fact, Bundy can mass-fabricate practically anything. And Bundyweld meets ASTM 254; Govt. Spec. MIL-T-3520, Type III. Our engineers will work with you at any time. Just call, write or wire: Bundy Tubing Company, Detroit 14, Mich.

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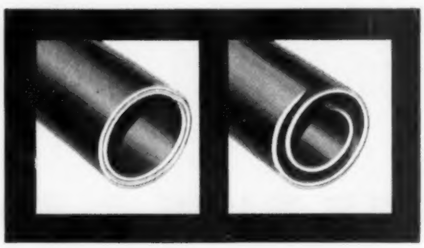

Bundyweld, double-walled from a single copper-plated steel strip, is metallurgically bonded through 360° of wall contact. It is lightweight, uniformly smooth and easily fabricated . . . has remarkably high bursting and fatigue strengths. Sizes up to ⅝" O.D.

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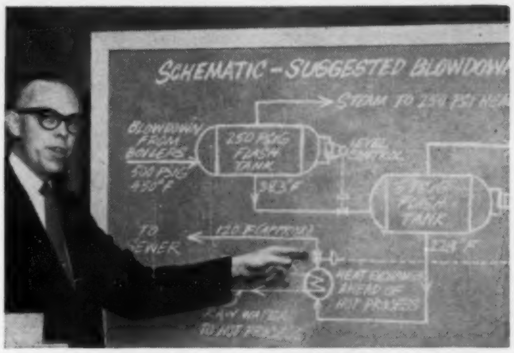
WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, BRAZIL, ENGLAND, FRANCE, GERMANY, ITALY, JAPAN.

A Nalco DEPARTMENT MANAGER

Answers the Questions Most Often Asked About Nalco Water Treatment Consulting Service

Experts Extend Your Staff Potential for Fast, Economical Handling of System Design, Chemical and Equipment Selection, and Plant Operations.



Selden K. Adkins, Manager, Nalco Consulting Service Department

Question: If a company's staff includes qualified design and operating personnel, why is Nalco Consulting Service needed?

Answer: Design, modification, improvement, and achievement of maximum economy in operation of water treatment facilities are highly specialized chemical engineering fields. Constant research and long experience in these fields enable Nalco engineers to supplement—*not* replace—the efforts of a company's staff by providing up-to-date information in their special fields.

Question: How does Nalco Consulting Service differ from the services of design consulting engineers?

Answer: Again, remember the specialized nature of water treatment engineering. Rarely can a company or consulting firm afford to maintain a staff of engineers who devote their entire energies to water treatment. Nalco, however, *does* have such a group of water treatment specialists that can act as an extension to the staff of the design engineer. These men have not only knowledge and experience in the intricacies of each of the specialized areas of water treatment, but the constant association with the rapidly changing technology of the field required to keep their information accurate and up-to-date.

Question: What return on investment does the cost of a Nalco consulting program provide?

Answer: Nalco Consulting Service reduces plant construction costs and saves *your* engineers' time. For example, assume that you need a new or completely modernized ion exchange water treatment plant. Nalco Consulting Service will help your engineers and/or design consultants establish the basic type and size of plant needed, *before* requests for bids are issued. Potential suppliers can then return bids faster and more economically. Also, your engineers can evaluate bids in a fraction of the time required for evaluation of bids on a variety of plant types. This reduces the overall cost of the system and releases the men involved for other projects.

Question: How is Nalco Consulting Service useful to an existing plant for which no immediate expansion is planned?

Answer: Few plants require or can afford a *full-time* water conditioning engineer – yet *all* plants find at times that they need the services of such an engineer. Nalco meets this need by supplying plant operators with the assistance they need, when they need it, to an extent determined by mutual agreement. Consulting service prevents many problems before they occur by anticipating the need for changes in chemical treatment control and application—giving you maximum benefit from every dollar spent on water treatment chemicals.

Question: Isn't consulting service usually supplied, free of charge, with the purchase of water treatment chemicals?

Answer: *Product application assistance* is offered for specific chemicals. Consulting provides an overall *program*. The complexity of many of today's systems requires attention to all phases of operations. While product application assistance is an important Nalco service to industry, often it should be supplemented with a consulting arrangement which provides the intensive and effective integration of *all* water treatment into a successful program.

Question: What do you mean when you say "the highly specialized nature" of chemical engineering as applied to water conditioning?

Answer: No one engineer can know every single detail that is important in each phase of an overall water treatment program. Coagulation, filtration, stabilization, softening, sludge conditioning, ion exchange, slime and microbiological control—all these and many more must be considered. Nalco's coagulation, stabilization, power industry chemicals, process antifoams, cooling water, and microbiology departments maintain an effective working knowledge of each of these special areas of water treatment. Each department manager is an expert in his given field, and is assisted by an average of 25 staff and laboratory personnel. Nalco's Consulting Department draws on the specialized knowledge of each of these groups to provide the engineering knowledge needed in each plant. By coordinating the efforts of all these specialists and utilizing the knowledge and experience of our national field force. Nalco can provide precise information to get successful results. That so many departments are vital in our operations indicates the degree of specialization necessary.

Question: How can a company that sells chemicals be a "true" or impartial consultant?

Answer: Regardless of affiliation, consultants are responsible for producing effective results. Nalco consultants have nothing to gain—and everything to lose—by recommending any chemical or method not in the best interest of the client. Water treatment products offered by Nalco (or any reputable company of this type) are usually special blends, each designed to do a specific job under a specific set of conditions. These specialized products would not exist if there was an *exact* equivalent "open market" chemical available. The Nalco Consulting Department recommends the most suitable chemical for a given situation—regardless of whether or not it is a Nalco product. The single objective of Nalco Consulting Service is to provide the client with maximum treatment efficiency, regardless of which chemical or equipment is used. Chemicals are no more than tools to the consulting engineer—what he provides are programs, methods, and results.

Suggestion: Ask your Nalco Field Representative, or write for illustrated 16 page Bulletin D1 for information on Nalco Consulting Services.

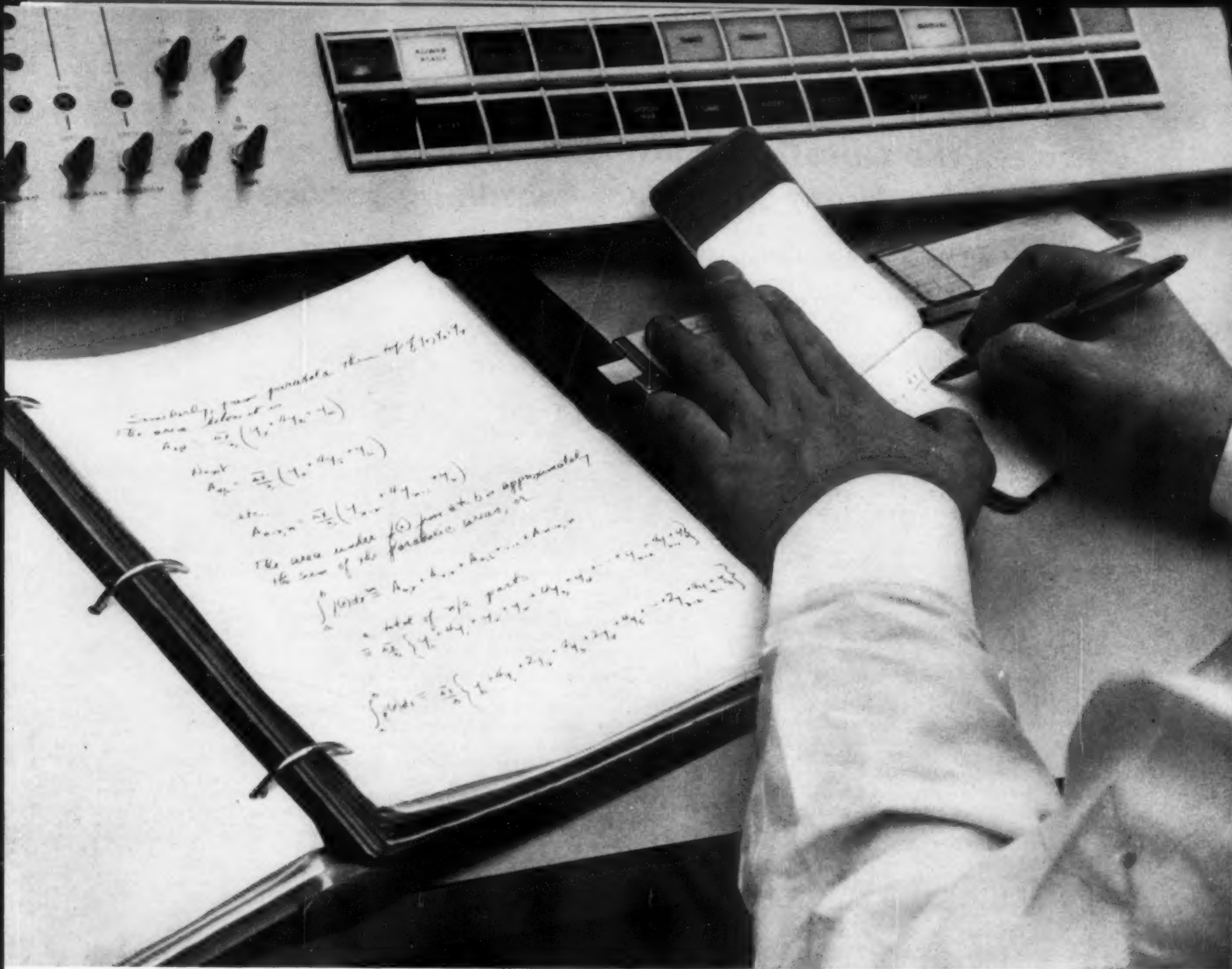
NALCO CHEMICAL COMPANY

6317 West 66th Place • Chicago 38, Illinois

Subsidiaries in England, Italy, Mexico, Spain, Venezuela and West Germany

In Canada: Alchem Limited, Burlington, Ontario

Nalco ®... Serving Industry through Practical Applied Science



Free engineers for creative assignments with the new low-cost IBM 1620

The IBM 1620 Data Processing System is a low-cost solution to the problem of freeing engineers for their most creative and profitable assignments. Here's why:

EASY TO USE—Just a two-day training class is all you need to put your 1620 into operation. This means no delays in learning to use the 1620 computer.

In addition, you get a wide range of free programming services including FORTRAN and GOTRAN. FORTRAN is the powerful scientific language that lets you solve problems without writing detailed computer instructions. GOTRAN is a simplified language (a sub-set of FORTRAN) that lets you enter simplified problem statements and data into the computer with the solution immediately available, in one simple operation.

FAST—The 1620 solves a set of ten simultaneous equations in only 20 seconds. It inverts a 10 x 10 matrix in just 42 seconds.

POWERFUL—The 1620 inverts a 40 x 40 matrix. With optional additional core storage the 1620 can handle matrix inversion problems of a much higher magnitude.

GET FULL DETAILS—The 1620 is the most outstanding engineering and scientific computer in its price range. A basic installation rents for just $1,600 a month.

To learn how the 1620 can free you for more creative engineering work, call your local IBM representative.

IBM's 1620 is a compact desk-size computer.

IBM®
DATA PROCESSING

MECHANICAL ENGINEERING

VOLUME 83 • NUMBER 2 • FEBRUARY, 1961

Engineers: More Jobs, Higher Salaries

Editor, J. J. JAKLITSCH, JR.

Although the U. S. economy continues to drag, it is gratifying to note that the news for engineers and scientists and engineering teachers is good.

According to the National Science Foundation, between January, 1959, and January, 1960, employment of engineers and scientists in industry rose nearly 7 per cent. There was only a 5 per cent rise in the 1958–1959 period.

More than 800,000 scientists and engineers were employed in January, 1960, by over 10,000 U. S. business firms covered by a survey conducted for NSF by the Bureau of Labor Statistics of the U. S. Department of Labor. This compares to the 764,000 employed by a similar group of firms in January, 1959.

About 80 per cent of the group covered by the survey were engineers. Of the remaining 20 per cent nearly half were chemists. Physicists, mathematicians, metallurgists, and geologists accounted for 35 per cent of the remaining scientists.

Industrial firms had a net increase of approximately 40,000 engineers between January, 1959, and January, 1960. This rise in engineering employment represented a 6.6 per cent increase—a much greater growth than occurred during 1958. Employment of scientists rose by more than 10,000 from 1959 to 1960—a 7 per cent increase.

Nearly 40 per cent of the engineers and scientists were engaged in research and development activities. This represents a significant increase over R&D employment in the previous year.

Arnold R. Deutsch, president of Deutsch and Shea, Inc., specialists in technical recruitment, said recently that . . . "indicators point to increased demands for technical manpower, both in the immediate and more distant future." He suggested that some of the points management and personnel people should consider with regard to technical recruitment in the 1960's include: (1) Improving prediction of professional manpower needs; (2) planning long-range recruitment programs; (3) improving professional climate within the company; (4) tightening administration of recruiting procedures; (5) effectively utilizing engineering and scientific staff.

Salaries and income of engineering teachers were up, too, a new Engineers Joint Council survey revealed. The EJC study noted that the total income of engineering teachers from both teaching and other engineering professional work increased from $9598 in 1958 to $11,013 in 1960, a gain of $1415 or 14.7 per cent. Over the same two-year period, the basic teaching salaries of engineering educators increased by a smaller relative amount. The rise in teaching salaries was $1006 or 13.4 per cent. The average of outside professional income went up by $408, a gain of 19.7 per cent from 1958 to 1960.

Other statistics of the report show that salaries increase with age, academic rank, and type of degree; that the median teaching salary for instructors is $5380, for full professors, $10,500.

Present figures point to a continuing demand for engineers. How long it will continue will depend, of course, on the farsightedness of management. New technologies are springing up rapidly and they must by manned. Not only our economy but the very future of our way of life will depend on a strong corps of well-trained engineers and scientists.—*J. J. Jaklitsch, Jr.*

WRITING:

One morning a young senior engineer in charge of vibration studies in a materials-testing laboratory is called into his supervisor's office. He is told that an important project involving the laboratory has been assigned to the section. The nature of the project demands close follow-up reporting of each phase, and these reports will greatly influence the outcome of contract negotiations in which the company is engaging. As senior engineer in charge, he will be responsible for excellent engineering and excellent reporting.

Elsewhere in the company, another engineer is putting the final touches on a paper which he is to deliver that evening. His audience will consist of men in the field of control systems, and his paper will be a major contribution to the evening's program.

In still another office, a research engineer hands his secretary a large brown envelope containing a manuscript. The envelope is addressed to a prominent magazine whose editors have asked to see an article explaining missile silos to the lay public. If the editors find his article acceptable, they will want a series on missile launch stands.

These three engineers are engaged in important work, that of explaining their profession and their ideas. In one way or another, their success in writing has determined, or will determine, their advancement within the company and their fulfillment as engineers.

If there is one axiom, one "rule," for these engineers to follow, what is it? What one thing will help them most in their writing aims? Does it concern grammar? Patterns of organization? Punctuation? Logic? It concerns none of these.

Writing Is a State of Mind

The most important advice that can be given to the engineer approaching a writing task is this: Develop the communicative attitude. Once this has been accomplished, problems of syntax and composition can be solved as surely as problems in basic algebra. After all, the engineer has been trained to think logically, to attack problems systematically. And by following any good style manual or English textbook,[2] he can learn where commas usually go and where they don't. All that is left is that the engineer must want to explain, must enjoy sharing his ideas with others.

Many persons are hindered by the idea that the desire to explain is the sacred ground of professional teachers and writers, that using language to expose themselves will expose things they don't want exposed. Such fright of writing is often the only stumbling block to persuasive and informative exposition. Only by developing the communicative attitude can the engineer assess his own particular writing problems and eliminate them, thereby eliminating at the same time his fear of these weaknesses.

For instance, in the case of the engineer assigned to report his work in the materials-testing laboratory, he can either look forward with dread to the job of writing, or he can think of such reporting as a challenge to expression. His love of his work as an engineer should not be limited to just the manipulation of his engineering tools; or, rather, he should think of words as tools, tools by which he makes his work known to his employers.

For the engineer who is to deliver a paper, there is an added thumbscrew of apprehension. If the first engineer must write a coherent paper concerning his work, at least he doesn't have to read it out loud to his audience.

Only in the cases of a few extremely gifted or experienced orators is there no stage fright whatsoever. We can all take comfort in this fact and go on from there. To "go on from there" means we can realize that an audience, in almost every instance, starts out on the side of the speaker, and will make concessions to almost any distracting factor—except boredom. Whether the engineer is delivering a paper or giving a talk without notes, he can have all the forensic afflictions of an amateur debater losing his first verbal battle, and the audience will stay with him if he has something to say in a pleasurable manner.

[1] Instructor in English, College of Engineering.

[2] Editor's Note: Your dictionary probably contains a section on "punctuation, compounds, capitals, etc." Or, take a second, analytical look at the sentences you are reading.

By Herbert Bohn Devries,[1] University of Colorado, Boulder, Colo.

The engineer who won't communicate diminishes both himself and his profession. It's basically a matter of attitude—the desire to understand and be understood.

Aptitude or Attitude?

Will He Ever Sit Down?

He should remember, of course, that one of the greatest pleasures he can afford his audience is brevity. Even an otherwise fine paper can be spoiled by failure to condense, failure to "concentrate" the material. In a talk, boredom is often a function of the length of presentation.

But, in the final analysis, only the bored are capable of boring. The engineer who is interested in his work and excited by his ideas will not be boring when he talks to other people. He has the communicative attitude, and this will, again, help him solve formal problems that always arise in the use of words.

The research engineer, who has written an article for a prominent magazine, will have the largest audience of all. His job, too, is exacting. He is not writing just for his supervisor and a few others; nor is he writing only for his professional peers. His audience comprises the lay public trying hard to keep up with the technological front expanding everywhere. This is the public baffled by pictures in the morning papers of aluminum balloons circling the earth and of strange buildings called "geodesic domes."

Obviously, the job of this engineer-writer is to explain the most that he can with the least amount of complexity, the least confusion. If he has the communicative attitude, he cares more about his audience than he does about himself. He wants them to understand, not just marvel at his technical proficiency. Consequently, he is always translating for them, translating professional language into the language of public domain.

Talk to the Reader, Not to Yourself

The key, then, to developing the communicative attitude is implicit in each of these three examples of engineers who were expected to use their language. In a sense, it is the same key any author uses to open doors to successful writing. It is achieved by the engineer-author who has a real interest in his audience, a real desire to be understood. Only when he has this interest does he relegate himself to second place and put his reader or listener in first place. Only then has he started developing the communicative attitude.

What is the incentive to developing this attitude, practical considerations of professional advancement aside? Actually, there are two incentives involved. The first is the pleasure that can be obtained from doing a good job of writing. And pleasure in writing will more often than not result in pleasurable reading. Again, the audience is the important factor.

The satisfaction of explaining well is a very real one, even though, admittedly, such satisfaction might sometimes come after the fact. A famous writer of the last century once summed up both the agony and the satisfaction of writing when he said, "I hate to write, but I love having written." The engineer who finds that he must grapple with his report or paper so that it reads accurately and concisely is experiencing the same struggle that even the best (especially the best) writers go through.

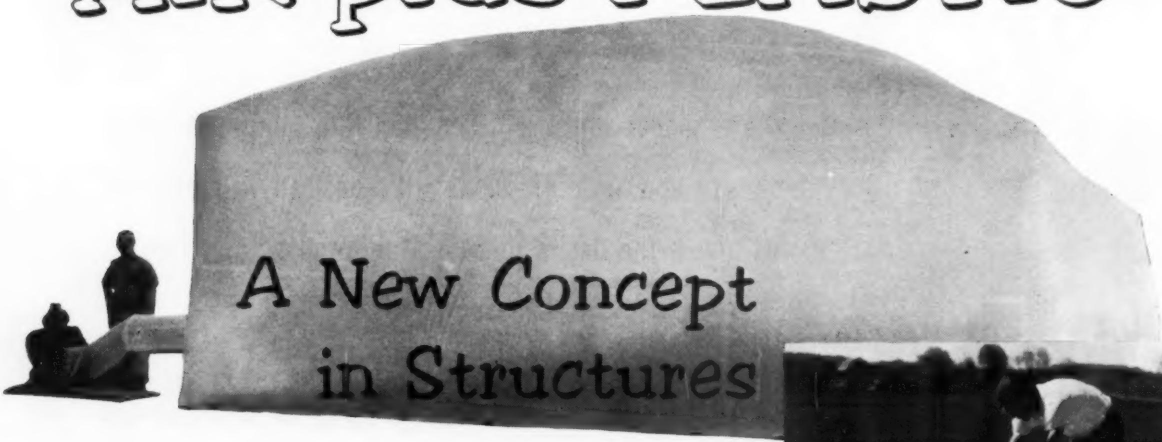
The Obligation to Write

The other incentive to developing the communicative attitude concerns the contribution which the engineer has to make to his society. In a scientific age, the engineer is the most important contact which society has with the practical applications of science which are shaping our national and social destinies. To him must go the task of explaining these applications and their effects. At a time when the public is being bombarded with every imaginable stimulus, from the television commercial to the foreign news report, the need is especially great for up-to-the-minute news on the technological front, the front on which international battles are being fought.

And now that such developments as the high-speed computing machine have allowed the engineer to become even more of a thinker, not only in his specialty but in the wider range of his interests as well, he can give attention to articulating his role professionally and as an individual in his society. He can do much to fulfill himself, to teach himself, and to show all of us the excitement of the years that lie ahead. Language in the hands of the engineer could have no better purpose than this, the end product of the communicative attitude.

AIR plus PLASTIC

A New Concept in Structures



This building shed, 26 ft × 60 ft long, can be produced to sell at $156.00 plus the blower. It is made of a reinforced polyethylene film, with a tensile strength of 20 lb per in., tear strength of 130 lb. It is translucent, and is designed to last three months.

Air Structures

In its simplest form, the air structure is a strong, lightweight, flexible balloon, anchored to the ground, but stabilized and supported solely by maintaining a small pressure differential inside the envelope. The envelope material provides the sole structural support; no supporting frames or ribs are required. As the thin shell is pretensioned and stabilized by air pressure and thus prevented from buckling, it is, in effect, a thin-shell structure long recognized as one of the most efficient structural shapes available to the engineer.

The pretensioned envelope can support compressive loads up to the value of the pretension applied. If this value is exceeded in local areas, the envelope simply distorts to redistribute the load. An air structure, buried under an abnormally high snow load, may deflect and become misshapen while the load is imposed, but will automatically return to its original shape as soon as the load is removed. This permits the use of a lightweight design, with assurance that the service life will not be impaired by abnormal conditions.

Reinforced Plastic Films

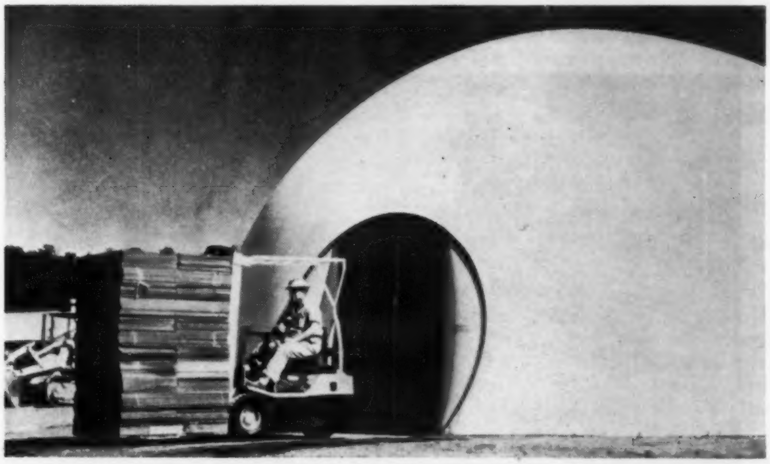
The ideal of any engineering material is to have infinite strength, zero weight, and zero cost. The closest approximation to this is a reinforced plastic film, where the reinforcements are free to slide so as to form a rope ahead of any tear which has started. The basic innovation here was to introduce fibers in a definite geometric pattern, such as a square or a diamond pattern, in a sandwich between two plastic films. Where the fibers were introduced in a fluid-adhesive medium, permitting sliding, maximum strength was obtained.

The character of the reinforced film as to durability in contact with various influences, mechanical and chemical, is determined largely by the nature of the film. For a minimum of coat, together with great extensibility, the polyethylene films and the polypropylene films are excellent. These are highly water-repellent, and are good for indoor uses without limitation of color and time. For outdoor uses, however, the black polyethylene film can well be used for a matter of years.

An aerial view of the Army Pentadome, said to be the world's largest fabric air structure. Total area, 50,000 sq ft; volume, 2,000,000 cu ft.

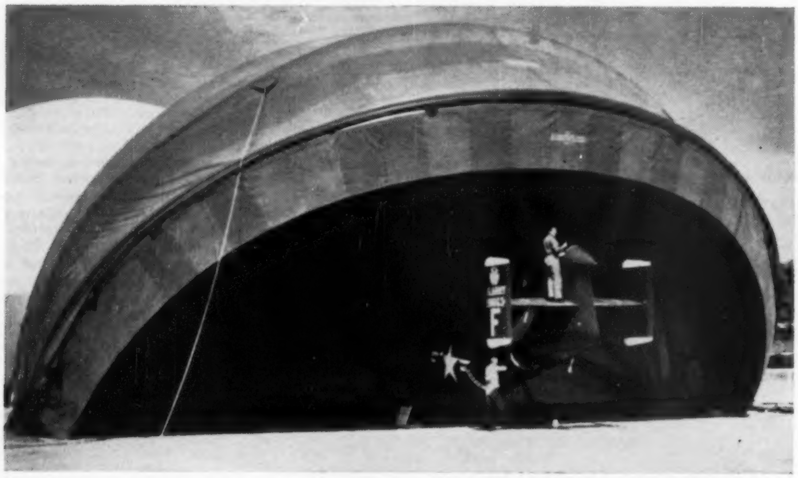
Hoist away. Air-minded young lady illustrates the tear strength of Griffolyn reinforced plastic film.

Erecting an air-supported building. At the **far left,** across the page, the building is deflected, folded, and packaged. At **left,** the building is unfolded, being set up. **Above,** the air-supported building is inflated. Bjorksten Research Laboratories and the Griffolyn Company suggest that additional uses for reinforced plastic films will be: Protection for pipelines above ground; as liners for horizontal storage pits; as blimps for water transport of liquids; in balloon construction, where the value of the cargo justifies the higher cost; and in light construction, a mechanical function combined with the vapor-barrier element. Possibility: Storable fall-out shelter.



A typical storage enclosure, **above,** built by Birdair Structures, Inc., for the Construction Division of du Pont. It is equipped with a bumper-operated door that will close against the inflation pressure, yet can be opened by bumping against it with a lift truck from either direction. **Below,** the same construction shelter, showing material being stored. Translucent fabric eliminates the need for artificial lighting during daylight hours. This structure uses a pipe-anchorage system for good distribution of load into the fabric, and to make a secure ground attachment.

For winter swimming. The enclosure rolls up on a tube like a rug, weighs only a little over 200 lb, and can be erected by a three-man crew in two to three hr.



This frame-stabilized air structure meets the problem of housing large equipment such as aircraft, where the airlock would have to be as large as the shelter. Combining the advantages of air support with a frame, the shelter is the lightest portable hangar developed to date.

A low-pressure, dual-wall structure. Structural support is provided by a cellular wall structure, and the interior need not be inflated, although it may be for additional security. This is an air-inflated, rather than air-supported, structure.

AIR plus PLASTIC

A New Concept in Structures

Based on two papers contributed by the Rubber and Plastics Division and presented at the Rubber and Plastics Conference, Erie, Pa., October 9–12, 1960, of The American Society of Mechanical Engineers. The papers from which this material was taken are:

"Air Structures—A New Concept in Design," by W. W. Bird, president, Birdair Structures, Inc., Buffalo, N. Y. Paper No. 60—RP-2.

"Reinforced Plastic Films as an Engineering Material," by Johan Bjorksten, president, Bjorksten Research Laboratories, Inc., Madison, Wis.; and William Cameron, president, Griffolyn Company, Inc., Houston, Tex. Paper No. 60—RP-1.

High equipment costs are the basic problem. But your justification figures won't tell the true story unless they're based on long-range planning, and unless they take the employee into consideration.

MECHANIZED WAREHOUSING OF CASE GOODS

By Arthur Spinanger,[1]
Procter & Gamble Company, Cincinnati, Ohio

Which of these two statements is correct: "There will be a completely automatic warehouse in the U. S. within two years;"[2] or, "The fully automatic warehouse does not exist and . . . it may never exist except in isolated cases?"[3] There is a measure of truth in each viewpoint. For example, one manufacturer estimates that an automatic order-picking system will save him $151,200 in annual labor costs. These savings are more than half the installed cost of the automatic system.[4] In contrast, a West Coast oil company with manual-handling costs of 7¢ per case found that a proposed automatic order-picking system would increase costs to 10¢ per case.[5] Faced with these contradictions, the problem is one of evaluating alternative mechanized warehousing systems.

Planning

Warehouse handling mechanization must be based on long-range planning for the entire company. Changes in either production or distribution may have a great effect on the results of a given warehouse equipment installation. Improvements in warehouse case-handling methods should be part of an orderly, planned approach to cost reduction; this planning is aided and guided by a warehouse concept. One concept views warehousing functions as part of an integrated system of men, materials, and equipment. The principles which help keep warehouse planning consistent with this concept are:

1 Perform all warehouse operations in one location.
2 Ship cases directly from production.
3 Unitize cases to be stored as soon as possible.
4 Transport cases in multiple unit loads.
5 Ship stored cases in unit load quantities.

A warehouse equipment evaluation may take long-range company plans into consideration, it may be consistent with company warehousing principles, yet failure to "sell" the equipment to operating personnel can prevent a successful application. As an example: One manufacturing company installed a "train" system to move multiple-unit loads of case goods within the warehouse. This handling system worked so well that a 30 per cent reduction in lift trucks and a 20 per cent reduction in operator time was possible. In a similar installation, another company found no basic improvement in its case-handling performance. Investigation pinpointed the cause of failure: Operators had reacted negatively to the trains. Neither operators nor supervision clearly understood how to use this system. Hourly personnel became suspicious of the change, and operating results reflected their lack of support. The difference between success or failure in warehouse mechanization can often be a human one.

Representative Warehouse

A representative warehouse will be used to develop a common basis for evaluating different handling systems (Fig. 1). This warehouse has 50,000 daily case shipments; receipts of 35,000 cases on conveyers from pro-

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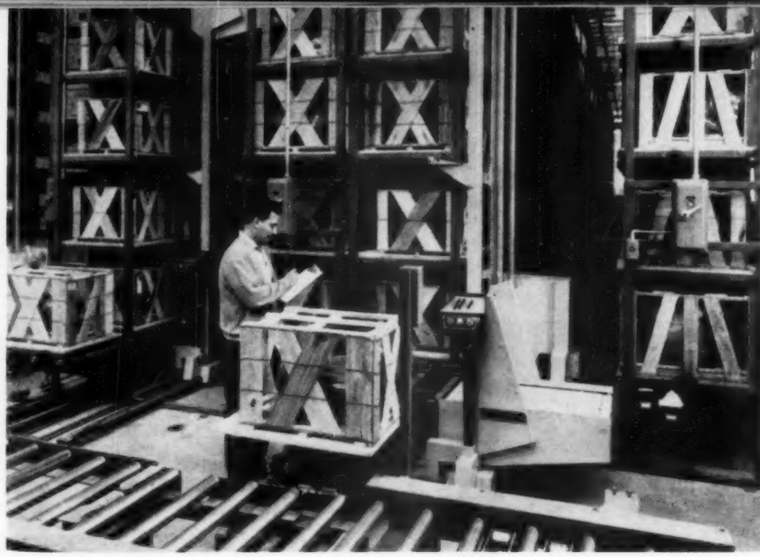
[1] Associate Director, Industrial Engineering Division.
[2] Irving Footlik, *Control Engineering*, June, 1958, p. 73.
[3] William H. Meserole, *Modern Materials Handling*, November, 1958, p. 119.
[4] "Near Automatic Picking, Sorting, Loading," *Modern Materials Handling*, April, 1960, p. 90.
[5] "The Push Button Warehouse," *Fortune*, December, 1956, p. 182.

Contributed by the Materials Handling Division, and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of The American Society of Mechanical Engineers. Paper No. 60—WA-95.



AN AUTOMATIC STORING-UNSTORING SYSTEM Loads are moved into and out of storage by one man with this push-button-controlled storing-unstoring system. These loads arrive on a roller conveyer (**foreground**) and are mechanically transferred to the storage carrier seen at the right of the operator. This carrier then travels horizontally down a 42-in-wide aisle and vertically up to a height of 20 ft to load or unload 600 to 900-lb loads from either side of the narrow aisle.

duction; unitized receipt of 15,000 consignment cases daily in trucks and railcars; cases going to three warehousing locations by lift trucks and flat-bed trailers; product moving between floors on elevators in one of the warehouses; and cases shipped by rail or truck.

Such a warehouse must be equipped to handle 200 product brand sizes. Shipments of 600 orders per day are made over a four-state area. 85 per cent of these shipments are made in unit-load quantities, while 15 per cent must be manually picked for small-quantity orders. Hourly employees assemble unit loads at a rate of 8 cases per min; manual order picking averages two cases per min. Wages and overhead are approximately $4.00 per hr. This warehouse operates on a two-shift basis, 250 working days a year. The employees work on an incentive system on which they produce and earn at a rate 25 per cent greater than normal.

In a warehouse of this type, there are six basic case-handling functions, outlined in Fig. 2. Complete evaluation of a warehouse mechanization proposal would require consideration of all six handling functions. To suggest the type of thinking involved, we will treat in detail only four functions—unitizing, storing, unstoring, and order picking.

Unitizing

Case unitizing involves removing individual cases of product from a production conveyer and forming them into a solid 4-ft "cube." This cube, composed of perhaps 40 tightly stacked cases, is then taken to storage. Pallets are often used to transport and store such cubes. However, in our warehouse example the cube handling is done without pallets. There are these three basic unitizing alternatives: The operation may be done manually; semiautomatic mechanical aids can be used; and an automatic operation is possible.

In our representative warehouse, only the cases from production need to be unitized; consignment cases from other company-owned warehouses are received in unit loads. On a typical day, the 35,000 cases from production might be composed of about 20 different brand sizes. Three brand sizes account for about half of the cases received daily (Fig. 3). Ten men a day would be needed to unitize this volume of product manually.

Is the proposed installation justifiable in dollars and cents? To evaluate the economic feasibility of new handling equipment, the "years-to-pay-out," an investment will be used. This payout figure is the installed equipment cost divided by the sum of net after-tax savings and depreciation. The installed cost of warehouse case-handling equipment is estimated to be 50 per cent higher than the purchase price.

Proceeding on this basis, a "payout volume" may be calculated. This payout volume will indicate how many cases must be handled daily on a unit-load former to enable a given payout on the invested capital.

Looking first at semiautomatic unitizers, the payout volume of a given brand size necessary for a four-year

MECHANIZED WAREHOUSING OF CASE GOODS

Fig. 1 The product-flow diagram of the typical warehouse considered in this paper. The warehouse is assumed to handle 200 product brand sizes.

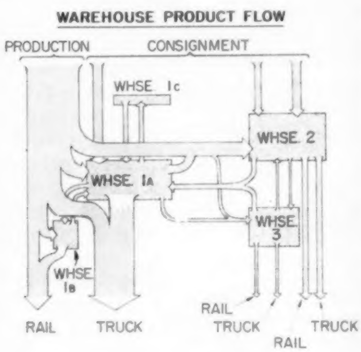
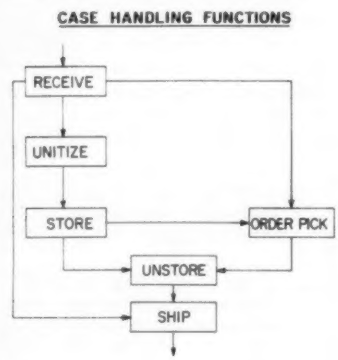


Fig. 2 Six basic handling functions of the representative warehouse. Handling functions must be integrated and controlled by an information system.



AN AUTOMATIC ORDER-PICKING SYSTEM Cases are released from 120 flow racks by punched cards in the automatic system pictured. A traffic control unit **(center foreground)** is shown converging cases released from two levels of the automatic system into a single line. These cases are later merged with cases picked manually from flow conveyers and pallet racks (not shown) to form the complete order. This order is then conveyed directly to the proper rail or truck spot for manual loading.

payout is 8200 cases per day. This is shown in Fig. 4. Actual production of only one brand size meets this requirement. Therefore only one such unitizer can be installed in our warehouse if equipment payout periods are limited to a maximum of four years. The type of semiautomatic unit-load former we are considering has a handling capacity of only 13,000 cases over a two-shift day. If one of these units could be installed in the representative warehouse to work at its handling capacity, the installation would still take 2.6 years to pay out. Generally, then, we could not expect any semiautomatic unit load former of this type to pay out in much less than 2.6 years.

An automatic unit-load former used on a single product (needing no accumulation lanes) must handle more than 12,000 cases daily to pay out in less than four years. In the warehouse which we are considering, only one product occurs in this volume (Fig. 5). Though the automatic unit will not pay out as quickly as the semiautomatic load former, it provides a handling capacity of 38,000 cases per two-shift day. In order to take fuller advantage of this capacity, we might consider feeding the three highest volume products to the automatic unit load former over three accumulation conveyers. The best payout in this case would be slightly more than four years (Fig. 6).

For various payouts, the justifiable handling equipment in our representative warehouse is shown in Table 1.

Even if an eight-year payout is acceptable, only three

Table 1 Economic evaluation

Maximum acceptable payout	Case unitization
2 Years	Manual
4 Years	1 Semiautomatic—best payout or 1 Automatic for one brand size—best capacity.
8 Years	1 Automatic with accumulation to handle three brand sizes.

of the twenty daily brand sizes would be automatically unitized. The low-volume products would still have to be unitized manually.

The basic ingredients in these payout evaluations are: Equipment costs, production volume, and wage rates. Depending on the direction of change in any one of these quantities, either more or less handling equipment is justifiable under the restriction of a maximum allowable payout. Take, for example, the automatic unit-load former for a single product restricted to a payout of less than four years (Fig. 7). Higher equipment costs make less equipment justifiable; higher wage rates make more equipment justifiable; increased shipments make more equipment justifiable.

The real situation is a complex combination of changes in wages, production, equipment costs, and other factors. Future changes in these areas should be estimated, and anticipated payouts calculated, to help indicate the best time to make an investment. This is particularly true of borderline equipment payouts. Suppose a unit load former has a $4^1/_2$-year payout today; it would not

Fig. 3 Three brand sizes account for about half the cases received daily. To unitize this volume manually would require ten men per day.

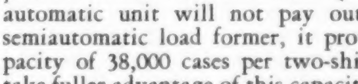


Fig. 4 If a semiautomatic unitizer could work at capacity, it would pay out in 2.6 years—handling 13,000 cases in a two-shift day. But no brand size quite meets this requirement.

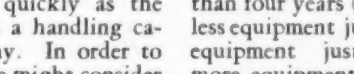
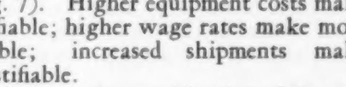


Fig. 5 An automatic unit can pay out in 4 years, handling 12,000 cases per day. But it is capable of handling 28,000.



CASE DEUNITIZER
The clamp pads (**center**): (a) deposit a unit load of cases on idling powered roller conveyers, (b) clamp all but the bottom layer, and (c) index up leaving a single layer of cases. Rows from this layer are next powered in the direction of the arrows where segregation and case turning occur. Finally, individual cases may be fed to the automatic order-picking system. This process is repeated until the entire unit load is broken down.

be installed under a rigid 4-year payout restriction. However, if a 2-year delay in installation would see an increase in the payout to six years because of equipment cost increases, and if there was a current need to improve the working conditions in this manual operation, then immediate installation would be recommended.

Storing-Unstoring

Storing and unstoring of unit loads of product may be treated as essentially similar case-handling functions. Some form of mechanized case storage has been feasible in most case-goods warehousing systems. Taking manual storage as the base, fork trucks have paid out the necessary investment in about a year. With fork trucks already in use, palletless case handling with clamp trucks has paid out in about three years. The major saving in this instance is the elimination of costly pallets with their attendant high annual repair costs.

In our 50,000-case warehouse example, the clamp truck system is the current unit-load-handling method. There are two basic alternatives to it:

1 Movement of multiple unit loads to and from storage with a clamp-train system, or:

2 Completely automatic handling of individual unit loads of case goods in and out of storage. The unit-load movement may be controlled either by an operator or by punched cards which have been developed for warehouse information and control purposes.

Table 2 The storage alternatives

System	Men	Capital investment	Annual expense
Manual	63	$ 3,000	$504,000
Clamp	18	100,000	186,000
Clamp-train	16	123,000	178,000
Automatic	2	900,000	114,000

Justification calculations show approximately a three-year payout for the clamp-train system in our representative warehouse. In the case of a completely automatic storing and unstoring system, it would cost an estimated $900,000 installed, and would pay out in about 10 years (Fig. 8).

How much money and how many men are involved in storing and unstoring product in this warehouse for the storage alternatives discussed? See Table 2.

Order Picking

The order-picking function follows this pattern: A cart is pushed through an area in which at least one unit load of each product is stored. Small quantities of the brands needed to fill orders are manually picked off these stored loads onto the cart, and it is pushed to the proper loading facility. A few of the 200 brand sizes account for most of the daily case shipments from the order-picking area, as the distribution of these 7500 daily order-picked cases shows (Fig. 9). Eight men are required to manually pick this daily case volume; the annual handling cost is $64,000.

Fig. 6 If we install accumulation conveyers and feed the three highest volume products to the automatic unit, we take greater advantage of its capacity, with a payout of slightly more than 4 years.

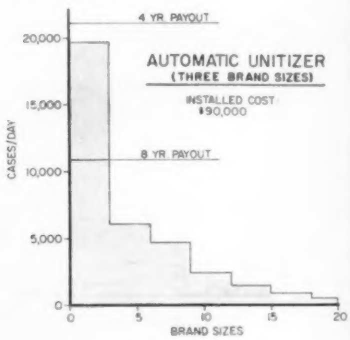


Fig. 7 More equipment—or less? If you can foresee the direction in which wages, equipment costs, and volume will go, you can estimate payouts.

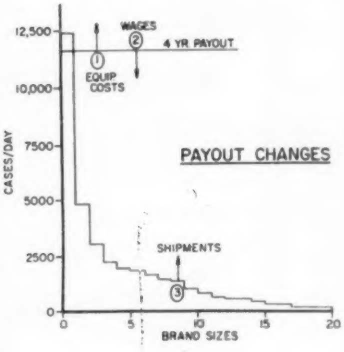
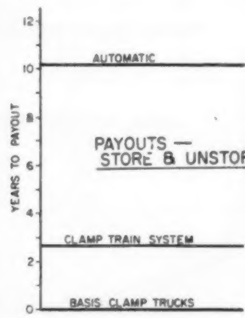
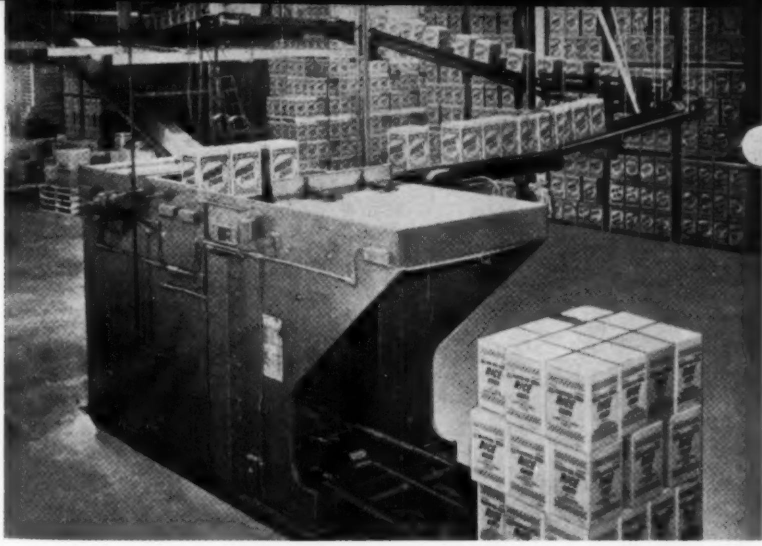


Fig. 8 With the clamp train system already installed, the next step would be completely automatic handling—a $900,000 investment with ten-year payout.





AUTOMATIC UNIT LOAD FORMER
On signal from the load former, a unit load quantity of cases is metered to it from one of several accumulation lanes (**upper left**). Case turning, toppling, and spacing devices then form the necessary row configuration. This row of cases is next powered to the right and another row is begun. When enough rows have been formed to complete a layer, a stripper plate supporting the layer is withdrawn and the layer is deposited on a pallet. The equipment then indexes down one layer, and the next layer begins.

Table 3 Profiles for 2, 4, and 8-year payouts

Maximum payout	Unitizing	Storing-unstoring	Order picking
2 Years	Manual	Clamp truck	Manual
4 Years	One automatic load former—single product	Clamp train	Manual
8 Years	One automatic load former—three-product accumulation	Clamp train	Automatic—32 lanes

One basic alternative to this manual handling is an automatic order-picking system. It consists of:

1 A deunitizer to break down unit loads for delivery of individual cases to storage racks.
2 Conveyerized storage racks holding individual brand sizes.
3 Punched-card control of case-releasing mechanism.

The installed cost of this system depends on the number of storage racks decided on. For our representative warehouse, the installed cost of a deunitizer, case-releasing mechanisms, and control system would run about $130,000; the cost for racks added to the system is estimated at $3000 each. If one brand size is assigned to a rack, it is possible to calculate the payouts for various combinations of products handled.

For systems of this type, there is a particular number of storage racks which gives an optimum payout, as shown by the low point on the payout curve in Fig. 10.

A semiautomatic order-picking system is another handling possibility; one type involves manual case feeding to the storage racks and manually controlled release of cases to various shipping points. Installation cost for the case-releasing mechanism and a manually operated releasing console is about $68,000. Storage racks would cost approximately $2500 each. Justification calculations based on our warehouse example show 45 storage racks as optimal. However, as the payout function in Fig. 11 shows, it will take 10 years to recover the capital invested in this system.

Table 4 Mechanization profile, 8-year payout

Function	Volume manual, per cent	Volume semiautomatic, per cent	Volume automatic, per cent
Unitizing	40		60
Storing-unstoring		100	
Order picking	30		70

Warehouse Profiles

What does the entire warehouse look like if investments in these separate case-handling areas are restricted to a two-year payout, a four-year payout, or an eight-year payout? These warehouse equipment profiles are shown in Table 3.

To gain perspective on today's "automatic" warehouse, our next question might be: How much manual case handling would there be in the representative warehouse if an eight-year payout period were acceptable? Table 4 shows this handling profile.

Therefore, even if an eight-year equipment payout were acceptable, a significant amount of difficult manual case handling would still be left in this warehouse.

Fig. 9 Small orders are manually picked out, amounting to 15 per cent of daily shipments: The remaining 85 per cent are delivered as unit loads.

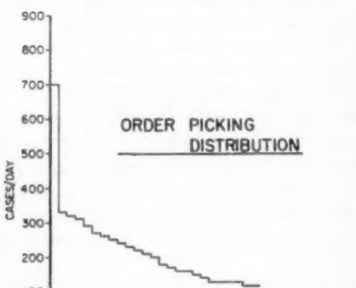


Fig. 10 The alternative to manual handling: Automatic order picking. Cost depends on the number of storage racks, a 32-rack optimum shown here.

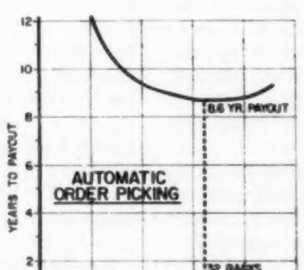
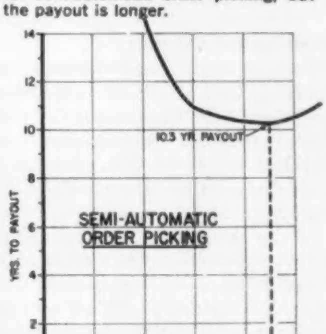
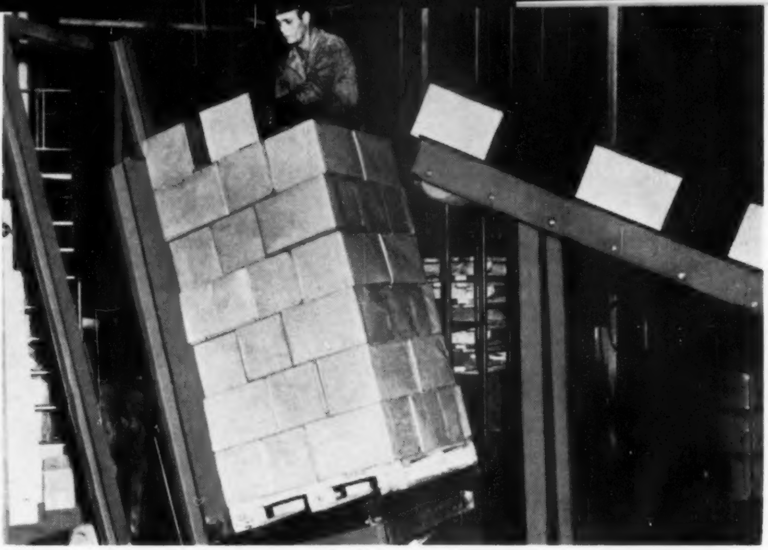


Fig. 11 Racks and controls cost less for semiautomatic order picking, but the payout is longer.





SEMIAUTOMATIC UNIT LOAD FORMER
Cases are manually formed into layers with the aid of this equipment. After each layer is formed, the operator indexes the load platform down one layer and begins forming the next layer until a complete load is ready.

Information Systems

It is difficult to anticipate the economic effects of a particular information system on mechanized case handling. Having warehouse data, such as stock location, outage, age, daily shipments, and production schedules on punched cards will improve warehouse planning. In fact, it may even be true that it is impossible to take full advantage of new handling equipment without an electronic data-handling system. However, it would be difficult to estimate the effect of electronic data processing on the necessary investment in warehouse personnel and equipment prior to an actual installation.

The effects of information systems such as punched-card data processing or closed-circuit TV are small at any specific point in the handling system. These information systems can be judged only after looking at improvements in all the varied case-handling operations in the system. In many cases, the total results are much greater than would have been predicted by adding the expected savings for each of the individual handling operations. As an example of this: Two-way radios were installed in a warehouse similar to the one in our example to improve the co-ordination of clamp truck and train case-handling operations. The initial justification estimated $20,000 gross savings on a $10,000 investment in radios. After six months' experience with the radio-directed operation, gross savings on the order of $100,000 appeared more reasonable. A significant part of this saving was due to a capacity increase. Several improvements in handling techniques, co-ordinated by two-way radio, had resulted in a lower-cost warehousing system.

Receiving and Shipping

Though only brief mention has been made of the receiving and shipping functions, this does not imply that they lack importance in the warehousing system. The current and anticipated methods of case receipt, whether it is individual cases on conveyers or unit loads from other plants, should affect new equipment thinking.

In the same way, evaluations of alternative handling methods depend on the nature of a company's shipments. What if the sales department decided, on an economic basis, not to accept orders of less than 40 cases? This change would enable future case shipments in unit load quantities via rapid loading highway trucks such as straddle trailers or conveyerized trucks. Any existing automated storage system of individual cases on flow conveyers would soon be made obsolete by this unit-load shipping method. Receiving and shipping are integral parts of the warehouse. They must be considered as such in evaluating alternative case-handling systems.

Why Mechanize?

Beyond the economic factor, there are very important additional considerations which can strengthen the economic justification of an equipment installation; or, they can overrule rejection of handling equipment because of unacceptable payouts. Mechanized case handling might be installed for such important, less tangible reasons as:

1 To reduce the work load variability and physical difficulty of manual case handling.
2 To provide better service to the sales organization.
3 To simplify complex manual case-handling systems.
4 To prepare for the possibility that current handling methods will not adequately meet future demands.
5 To provide for future capacity needs.
6 To improve management's control over a large and highly variable area of company cost.

These reasons apply to each handling function in the warehouse. While their value cannot be directly calculated, management's experience can translate the importance of each of these reasons into a dollar figure in evaluating case-handling equipment.

Conclusion

Today's warehouse needs automatic case-handling equipment, yet payout periods of eight years are too long in most cases. High equipment costs are the basic problem. For example, in a recent justification study, it was found that if an automatic unit-load former could have been purchased for $1.00, and installed with a three-product accumulation system, the installation would still have taken four years to pay out. Costs for the "accessories" alone (case detecting and diverting equipment, flow racks, powered conveyer sections, rack discharging mechanisms, control wiring, etc.) led to such a payout. This justification is not unrepresentative; it was calculated for what seemed to be a good potential unit-load-former application.

Lower costs for both accessory equipment and basic components will help bring about the justification of case-handling equipment not now considered feasible. This will require a co-operative investigation of equipment costs and handling needs by suppliers and users.

SAFETY
Regulations for Radioisotopes

Radioisotopes represent the first—and so far the most valuable—peaceful application of atomic energy. Here are the licensing and regulatory procedures by which AEC assures safety in their use.

By James R. Mason,[1] U.S. Atomic Energy Commission, Washington, D.C.

THE U. S. Atomic Energy Commission's Division of Licensing and Regulation has the responsibility for the licensing of by-product material (radioisotopes), source material (natural uranium and thorium), special nuclear material (fissionable material), and nuclear reactors. We are concerned, here, with the use of isotopes, that part of the regulatory program which deals with the licensing of by-product materials.

Not all radioisotopes are licensed by the AEC. Those which occur in nature and which are produced in accelerators are not subject to the AEC licensing regulations. By-product material is defined in the Atomic Energy Act as any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material. This legal definition may be paraphrased by simply stating that the AEC has the authority to license any radioisotope which is produced in a nuclear reactor.

The Atomic Energy Act of 1946 authorized the AEC to distribute radioisotopes to anyone who was equipped to handle these materials safely. This basic concept for distribution of radioisotopes has not changed. The Atomic Energy Act of 1954 was more explicit and authorizes the AEC to issue general or specific licenses to applicants seeking to use by-product material for research or development purposes, for medical therapy, industrial uses, agricultural uses, or such other useful applications as may be developed.

To put this authority in practice, the AEC placed in effect in February, 1956, a specific regulation which set up the criteria for issuance of licenses. This regulation is Title 10, Code of Federal Regulations, Part 30, "Licensing of By-product Material."

One of the first subjects in the regulation is a statement of who must have a license for possession and use of radioisotopes. Almost everybody has to have a license, except AEC-owned and operated facilities, and common carriers, exempted from the licensing regulations.

General License

A "general license" is one which does not require an application to be submitted to the AEC and is published in 10-CFR-30. It is a ruling which states that anyone may use radioisotopes in accordance with the label on the package. This "license" provides for the possession of quantities of radioisotopes which are believed to be small enough to be safely handled even by persons without radioisotope training and experience.

There are inherently safe specific items which may be obtained under a general license; these include vacuum tubes containing minute quantities of radioisotopes, and static-elimination devices containing radioisotopes. These items are manufactured and distributed in accordance with a "specific license" to be discussed shortly.

In February of 1959, the Commission issued an amendment to 10-CFR-30 which provides that devices such as measuring, gaging, and controlling equipment containing sealed sources may be distributed under general license. The distributor of such devices must have a specific license and must show that under normal conditions of use no person will be likely to receive more than 500 mrem[2] of radiation per year, the by-product material will not be lost, the by-product material will not be accessible to unauthorized persons, and the devices will be appropriately labeled.

The label is the heart of this general-license concept. This license procedure presumes no special knowledge or equipment, but users must follow label instructions. The general licensee is not permitted to service, install, or in any way handle the by-product material. These

[1] Chief, Isotopes Branch, Division of Licensing and Regulation.

Contributed by the Safety Division and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 60—WA-228.

[2] Millirem. "Rem" means "Roentgen equivalent, man," and is the dose of any ionizing radiation that will produce the same biological effect as that produced by one roentgen of high-voltage x-radiation.

SAFETY

Regulations for Radioisotopes

functions must be performed either by the distributor or a person specifically licensed by the AEC to perform these functions. The Commission has under consideration other amendments to 10-CFR-30 which would exempt from licensing certain devices and sealed sources which are believed to be inherently safe because of their design, the isotopes contained in them, and the method of manufacture.

Specific License

For a specific license, an application must be submitted to the AEC. The general requirements for approval of an application are that the applicant has: (*a*) Proposed a use authorized by the Atomic Energy Act of 1954; (*b*) equipment and facilities adequate to protect health and minimize danger to life or property; (*c*) personnel qualified by training and experience to use the material for the proposed use in such manner as to protect health and minimize danger to life or property.

Now, these are rather broad requirements and not specific enough for any particular type of program. In industry, programs may range from the use of a few microcuries to thousands of curies, and soon millions of curies of isotopes; from simple laboratory manipulations to highly complex setups; from relatively safe to extremely hazardous radioisotopes; and the conduct of programs by people with widely varying knowledge in the field.

The regulation does have specific requirements on how to submit an application for a license. The application form requests information on the identity and address of the prospective licensee; the quantity, type, and chemical or physical form of the desired radioisotopes; the training and experience of the individual user and the radiological safety officer in the safe use of radioactive materials; the purposes for which the by-product material will be used; the instrumentation, facilities, and equipment available; and procedures for radiation protection and waste disposal.

Because of the range of programs which may be carried out, the application form does not always provide all the information necessary to review an application. For example, the use of sealed sources in nondestructive testing of welds requires that special consideration be given to the instructions to personnel who actually perform the work. It is management's responsibility to provide such instructions and these are incorporated into a license by reference. In another case, manufacturers of sealed sources are required to submit information on the design, fabrication, labeling, quality-control procedures, and leak-testing procedures for the sources which they may wish to distribute to other licensees. Once a source has been reviewed and found to be adequate, a license may be issued to a person who requests that particular source. The same criterions apply to manufacturers of devices in which sources may be used. You should keep in mind that the reason for requesting such information is radiation safety, and not an effort to determine that one manufacturer's sources and devices are better than another manufacturer's.

The regulation further requires that every licensee maintain records which will reflect the receipt, transfer, and disposal of by-product material. There is also a provision which affords the Commission the right to conduct inspections of the premises and facilities where by-product materials may be used or stored by a licensee.

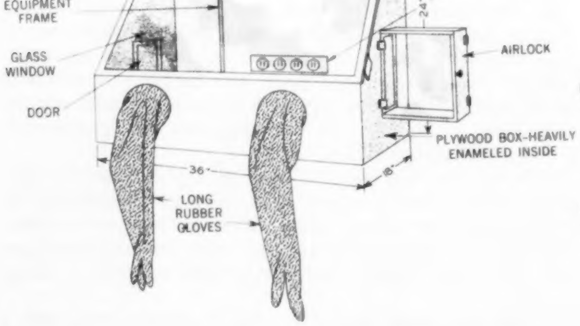


Fig. 1 Gloved boxes should be used to prevent ingestion of contamination when handling alpha or beta-emitting materials

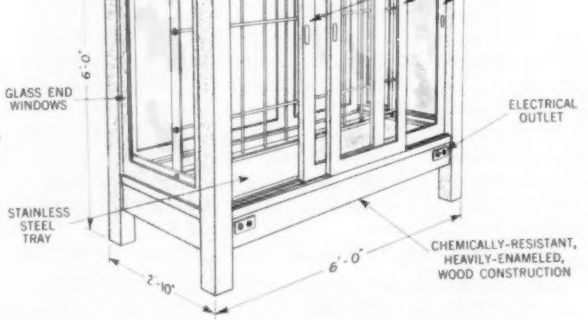


Fig. 2 A glassed-in hood is suitable for chemical synthesis with soft beta emitters such as carbon 14, sulphur 35, and tritium

A license also carries with it the authority to export by-product material to any foreign country except Soviet-bloc countries. There are some exceptions to this general statement. Only those materials which have Atomic Number 3-83 can be exported without any further licensing action. Radioactive hydrogen, commonly called tritium, polonium, and the transuranic elements require a special license for export. The export of any by-product material to a Soviet-bloc country requires a specific license for that purpose. Any licensee who exports by-product material is required to report the export to the Atomic Energy Commission within 90 days of the date of export.

Protection Against Radiation

Anyone who has an AEC license must conduct his program in accordance with Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation." In January, 1957, the Commission adopted this regulation which was based on many of the recommendations made in National Bureau of Standards publications and by the National Committee on Radiation Protection.

One of the first subjects dealt with in Part 20 is permissible doses, levels, and concentrations. At the present time, persons who actually use radioisotopes are permitted to receive a maximum of 300 milliroentgens of radiation in any one week. An amendment to 10-CFR-20 has been published in the Federal Register and will become effective on January 1, 1961. This new regulation will lower the maximum permissible dose to 5000 millirems per year in keeping with the recent, more conservative recommendations of the National Committee on Radiation Protection. Any person who is not considered to be a radiological worker is permitted to receive only 10 per cent of the radiation allowed persons who actually work with isotopes.

There is included in Part 20 a table which lists the maximum permissible concentrations of radioisotopes which may exist in air and water. This table is further broken down into two sections; one dealing with concentrations permitted in areas under the control of the licensee, and the second dealing with concentrations in areas beyond the control of the licensee. As you might expect, the concentrations permitted in uncontrolled areas are considerably lower than those permitted in controlled areas.

The regulation includes requirements for surveys of areas in which radioisotopes are used to determine if there is any contamination and whether the concentrations of the isotopes on equipment and in the air are

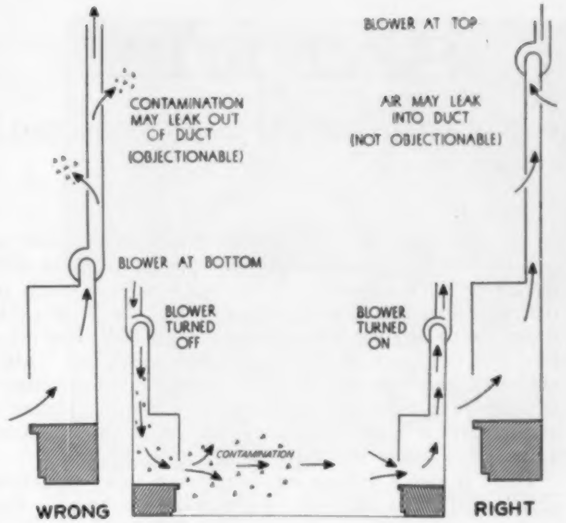


Fig. 4 Right and wrong hood-blower location: Blowers should be at the top, avoiding leakage. Improper hood control: Multiple blowers must work together.

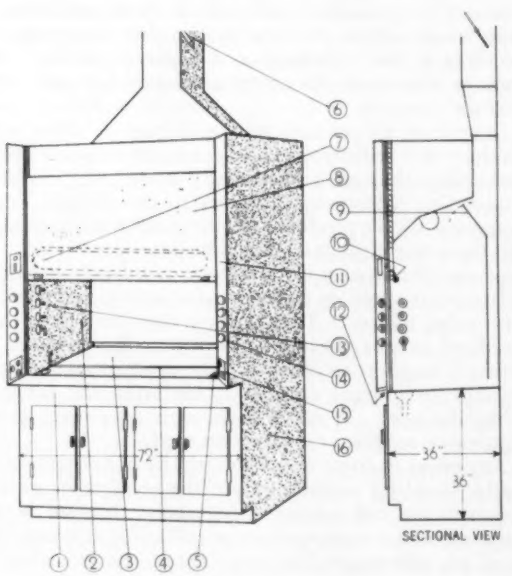


Fig. 3 Desirable features for a general-purpose fume hood are:

1. The hood should be resistant to heat and chemical action
2. Washable, strippable paint which may be peeled off if contaminated
3. Absorbent paper with waterproof backing to cover the working surface
4. For proper fume control, all operations should be performed beyond a safety line painted 8 in. inside the face of the hood
5. Easily cleaned cup sinks, located near the front of the hood
6. Air velocity of 50 to 80 fpm at the face of the hood with the sash wide open is set by an exhaust-duct damper
7. An air bypass prevents excessive velocity at the work surface
8. The counterbalanced hood sash may be made of tempered safety glass
9. A movable section of the back baffle, to withdraw fumes
10. A trough carries any condensate to the ends of the hood
11. A 6-in. "picture-frame" airfoil at the sides and bottom of the hood reduces turbulence of air entering the hood
12. Vent space between the bottom airfoil and the hood body improves air flow
13. Service outlets (gas, water, vacuum, etc.) located near the front of the hood to keep operator's hands out of hazardous zone
14. Service handles and electric outlets located outside the hood
15. Plenty of electric outlets: no circuit overloading
16. Base structure should be strong enough to support a ton of shielding.

SAFETY

Regulations for Radioisotopes

within the prescribed limits. Licensees are required to supply personnel monitoring equipment such as film badges or pocket dosimeters to anyone who is likely to receive a dose in excess of 25 per cent of the permissible limit, or to anyone who enters a high radiation area. For the purposes of the regulatory program, "high radiation area" means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

There is also a definite meaning given to a "radiation area" similar to that of "high radiation area." For

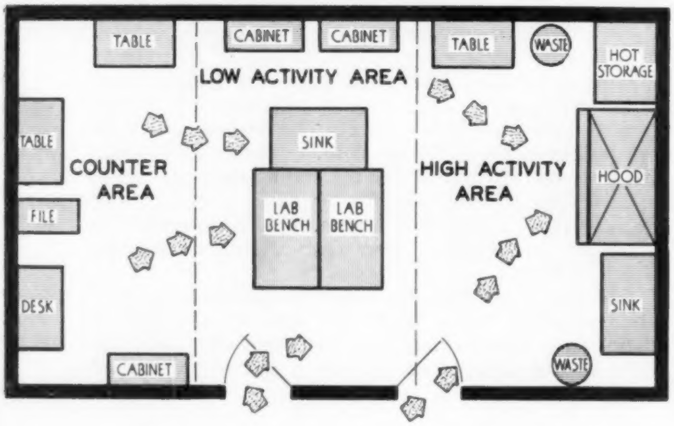


Fig. 5 Laboratory layout, showing air-flow pattern for ventilation. Air flow should be from low-activity areas to high-activity areas, to prevent possible cross contamination of other laboratories.

purposes of the regulation a "radiation area" is defined as any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 days a dose in excess of 100 millirem.

This does not mean that any area in which there exists a dose rate of 100 milliroentgens per hour is a high radiation area. For example, if a given area has a radiation level of 150 milliroentgens per hr for a period of only 15 min, this would constitute a radiation area because a person could receive in excess of 5 millirem but not in excess of 100 millirem during one hour.

The regulation requires that caution signs and labels be used when necessary. Both radiation areas and high radiation areas must be posted. Storage containers must also be labeled to indicate that radioactive materials are in them. In all cases, the radiation caution symbol in appropriate colors must be displayed. There have been several different variations of the radiation caution symbol used in the past; the only symbol now legally acceptable for use by licensees is the one which is defined in the regulation.

Disposal of Radiation Wastes

One of the problems which faces licensees is the disposal of the radioactive wastes generated in a radioisotope program. There are three methods which may be used by licensees which do not require specific approval by the AEC. One method is by transfer to another licensee authorized to receive the material. A commercial waste-disposal agency would be such a licensee or, in the special case of sealed sources, the original supplier of the sources would be authorized to receive the material.

The other methods of disposal would be in accordance with the provisions of Part 20 which provide for the disposal of wastes in the sewer system or by burial in the soil. For sewage disposal, there are restrictions on the quantity and concentration of radioactive waste which may be disposed of in this manner. However, this method of disposal is the one in most common use for the programs which use radioisotopes in liquid form.

The method of disposal by burial in soil is not used to any great extent. The amounts of waste which may be buried are restricted to certain small quantities. The depth of burial, which must be at least four feet, and the restriction on the number of burials per year have not made this method particularly attractive to licensees.

If a licensee wishes to dispose of waste by some other method, it can be done only after specific approval by the AEC. One method which has been used to some extent is incineration of combustibles and animal carcasses. For those isotopes which are completely volatilized in the incineration process, such as carbon, sulfur, and hydrogen, the main consideration is the concentration in the air at the point where it leaves the control of the licensee.

For other isotopes, the incineration process is one of concentration of the radioisotopes in the ash. Special consideration must then be given for monitoring the ash and its ultimate disposal.

Records of Exposure

Licensees are required to keep records of the radiation exposure to personnel, and records of all radiation surveys which are made. One point often overlooked by licensees is the recording of a negative survey. Such findings may turn out to be an important part of the licensee's records.

In spite of all precautions which may be taken in the conduct of a radioisotope program, there is always the possibility that an accident may occur. Licensees are required to report any accidents to the Atomic Energy Commission. Depending upon the extent of the accident, the reporting time may be immediate for a large overexposure of a worker or the release of a large quantity of radioactivity, and up to 30 days for an accident which is relatively minor. The purpose for reporting such accidents is not that AEC desires to be punitive but rather is an effort to determine the cause of accidents and attempt to prevent similar accidents in the future to other licensees. It is only through experience that a regulatory program can function well.

Any effort to cover up an accident by not reporting it is really "kidding yourself" since the necessary corrective action might not otherwise be taken. If some worker does receive an overexposure of radiation, not reporting it to his supervisor does not change the fact that the worker was overexposed. It is management's function to impress upon the workers the need for complete honesty and the AEC's attitude on reporting of accidents.

Inspection

As mentioned previously, Part 30 expressly gives the Commission the opportunity to inspect the facilities of licensees. The Division of Compliance carries out the Commission's licensee inspection program. Eight Compliance Division offices are located in the major Operations Offices around the country. Each of the offices is assigned a portion of the country on a geographical basis. It is the function of the Compliance Division to inspect licensees for compliance with the regulations and the conditions of their licenses.

It is the goal of the Compliance Division to visit all licensees. There are now over 5700 by-product material licensees of which some 1700 are classified as industrial users. In addition, there are licenses for source and special nuclear materials, fuel-fabrication facilities, and reactors. In scheduling visits to licensees, priority is given to the more complex programs and those involving larger quantities of more hazardous isotopes.

In well over half of the inspections no violations of the licenses or regulations has been found. Those violations which have been found are almost always a lack of awareness on the part of the licensee rather than a willful disregard of the regulations or license. We have found that when these matters are brought to the attention of the licensees, the response and correction are usually prompt and satisfactory.

Actually, since most violations are easily correctable, there is more instruction than enforcement in the inspection program.

About 85 per cent of the reported violations are easily avoided. The inspectors will not be at all angry if you know what these points are, since their goal is not to see how many violations they can report. The inspectors have found that the setting up of restricted and unrestricted areas; control of exposures of individuals in restricted areas; the making of physical surveys in areas where isotopes are used; the use of proper signs and labels; methods of waste disposal; records of surveys, radiation monitoring, and disposal; and possession of by-product material without a valid license are the most frequently reported violations. These violations can easily be avoided by more familiarity with the regulations and constant enforcement of them in any isotope program.

Obligations of the Licensee

When a license for the use of radioisotopes is issued, the licensee assumes the obligations of meeting any special conditions placed on his license as well as the provisions of Federal Regulations. There should be a strong internal control of a radioisotope program to insure that these obligations are met. Management should take an active interest in the control procedures set up by the trained personnel within the organization and set up strong administrative control of the program.

The responsibility of management to insure the safe use and handling of radioisotopes is not one that should be delegated and immediately forgotten. There is not only an internal responsibility but also the responsibility of good public relations. A radiation incident might possibly destroy much of the good will which a company or the over-all atomic-energy industry has built up through the years. If there is good co-operation between the Commission, management, and your atomic-energy departments, the use of radiosotopes can be both safe and beneficial.

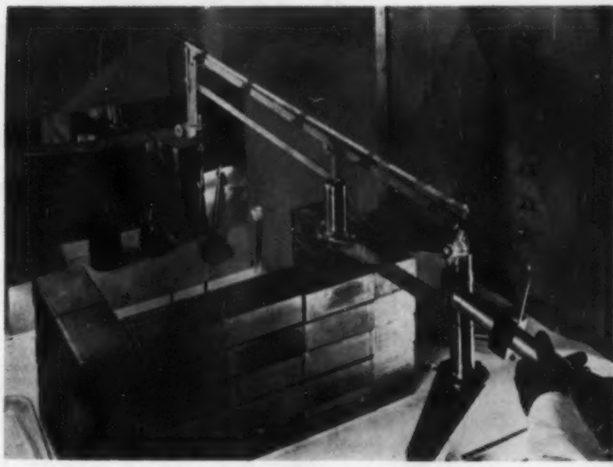


Fig. 6 Remote pipetting for gamma-emitting radiochemicals. The apparatus includes shielding, viewing mirror, and absorbent paper to control contamination from spills.

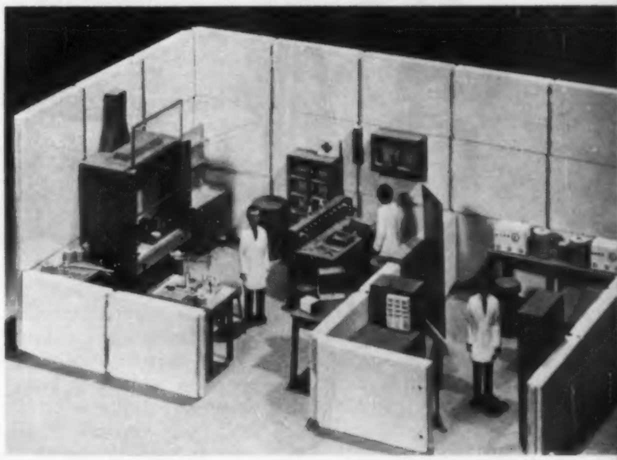


Fig. 7 Model of a two-room radioisotope laboratory, showing fume hood, typical furnishings, handling tools, pipetting devices, and counting instruments. Lab at **left** is segregated.

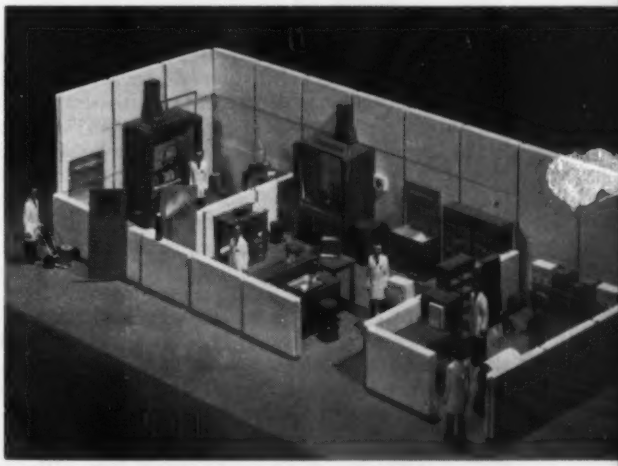
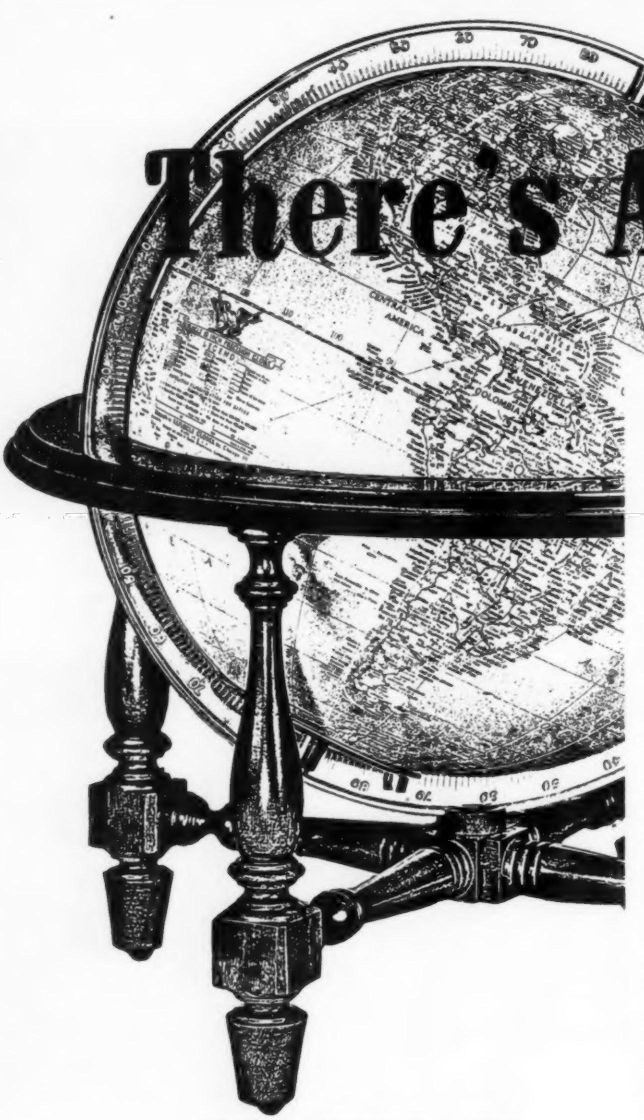


Fig. 8 A three-room laboratory. Laboratories should be segregated according to levels of activity handled—in this case, high activity, **left**; low activity, **center**; counting room, **right**.

There's Always the



The engineer is now deciding

By C. C. Furnas, Mem. ASME

Chancellor, University of Buffalo, Buffalo, N. Y.

In the spring of 1955, a secret committee of nine scientists and engineers was appointed to advise the Assistant Secretary of Defense for Research and Development on the feasibility and desirability of launching an instrument-carrying earth satellite during the International Geophysical Year, Jan. 1, 1957, to June 30, 1958. An intelligence report had been presented to the National Security Council indicating that the Soviet Union was working on a satellite project and might achieve success in the not distant future. It was anticipated that such a technological feat would have great propaganda and prestige value.

Taking this nontechnical factor into consideration, a minority of the committee recommended the use of the existing Army Redstone rocket rather than depend on the development of a new rocket, Project Vanguard. Had it been followed, America would almost certainly have had a satellite in orbit before the Russians.

This would have been an engineering decision based on sociological factors operating in the far places of the world. It is interesting to speculate what the course of history might then have been. Certainly, many of the events of the past three years would have been different—perhaps significantly so.

The creation of the positions of Special Assistant to the President for Science and Technology, and the Scientific Attaches at the ambassadorial posts is evidence of the impact which scientists and engineers have in passing judgment on nontechnical matters. The criteria for making such judgments are not to be found in any textbook. The role of the engineer in our national well-being is far more complex than in the good old days of a generation ago.

It might be revealing to review some other items of technology which involve aspects of judgment not traditionally classed as engineering decisions.

A Problem in Aesthetics

One of the outstanding structures in our country is the George Washington Bridge which spans the Hudson River at New York City. In the original design, the two supporting end columns of this great suspension bridge were to be covered with masonry, in keeping with tradition, on the economic grounds of protection of the steel structure from the weather. After considerable argument the design was changed, eliminating the masonry and leaving the steel towers with the open, lacy structure exposed. The decision was made on the presumption that open towers would be more beautiful than ones covered with a layer of somber stone. Here was a case where the decision was made on the basis of aesthetics rather than the usual engineering criteria plus economics.

Sociological Values

One of the most debatable and debated projects of the New Deal days was the Tennessee Valley Authority development involving power dams, flood control, and the introduction of new industries. The arguments ranged from the "saving humanity" theme of the enthusiasts to the cries of "economic boondoggle" of the conservatives. The decisions were not made on a strictly economic or engineering basis. Essentially they were made with an eye to the sociological values involved, even though some of the critics said it was entirely partisan politics.

It is not possible to set up a national balance sheet to determine whether or not TVA has been "profitable" in the purely economic sense. The point is that sociological factors, other than simple profit and loss, have in the past, and probably will in the future, enter more and more into the major decisions involving certain engineering projects.

The national rural electrification program involved the

Condensed from a paper presented at the Engineering Management Conference, Chicago, Ill., September 15–16, 1960, held jointly by The American Society of Mechanical Engineers and eight other engineering societies.

Sociological Factor

the form of the world in which people must live. Does he have a broad enough view?

Federal support of a widespread rural network of electrical systems which individual power companies, either privately or municipally owned, could not justify on the basis of anticipated earnings. The debates on this subject were bitter, with many accusations of political skullduggery and wastage of Federal funds. There is little debate, however, about the sociological as well as the economic gains that have resulted for the rural customers. This, again, was a pattern of major decisions based on over-all sociological, rather than economic, gains.

There is also a different type of problem, one which looks to the future. The 1960 census reveals significant trends in American metropolitan centers. The core communities (downtown) are steadily losing residents, and the suburbs beyond the city line are growing, more or less explosively. Whether it be from logic or habit, the business affairs remain concentrated in the central portion of the cities which the thousands have abandoned as a place of residence. This leads to the twice-a-day cycle of utter congestion of driving to and from work, with its attendant irritation, lost time, and struggles for parking space. Does it really make sense? No one seems to have a definite answer.

Suppose an imaginative engineer, with the aid of architects, sociologists, and economists, were to start anew to plan the occupation and use of a bare piece of real estate centered on Manhattan Island, with an operating radius of 50 miles. What would a plan for the existence and business of a community of 10 or 12 million people look like? No one has made such a comprehensive study. A serious investigation of this sort would necessarily involve a heavy emphasis on logistics, including operational research. It would require a great deal of imaginative engineering. From such a beginning it might be possible to chart the course of future urban development over a 50-year period.

The Socioengineering Problem

Where are the engineers who will spearhead such studies? Adequate talent is available if it were properly oriented. This Gargantuan task is brought up because when and if such studies come to a point of decision, economic, sociological, and logistic factors will certainly loom as large as technology. However, the decisions which must be made will be essentially engineering in character, if one accepts the definition of engineering as the solution of problems of organized complexities.

Within the next half century, the world population will undoubtedly expand from the present two and three-quarter billion to five or six billion. From whence will come all the energy, minerals, and water to provide physical wherewithal for these many billions of people? The expenditures for the necessary investigations can hardly be justified by individual private industrial organizations for the simple reason that financial profits will be a long time coming, if ever. Yet, if the nations of Western civilization, particularly America, do not undertake such studies, the communist countries undoubtedly will—and they will use this path of technological progress to capture the uncommitted nations.

What research and engineering developments should our nation undertake to solve the problems of the continuing supply of natural resources? Who should carry them out, and how should they be financed? These questions represent points of critical decision. The engineer will certainly have to play a primary role'

Suggestions Are in Order

These examples touch on matters which obviously involve public bodies: Municipalities, states, the nation, and even the world community. The trends of the immediate past and the prospects of the future all seem to give evidence of an increasing trend toward the welfare state. To one such as myself, who strongly believes in individuality and a free economy, this is a disturbing thought. But who has come up with any valid suggestions to counteract the trend? Those who contend that this is merely a matter of politics are evading the issue. The politics is an aftermath, not a cause. Sociological and technological factors are the most important.

It is quite evident that there is not now enough human talent (and probably not enough financial resources) to do all the wonderful things which America seems to be demanding. Patterns and programs seem to evolve at random, or are arrived at by default. It may be contended that some great decisions should be made, but unless we are to be the subjects of an omniscient dictator, who is to make them? Such decisions in our complex world involve matters which are for the most part beyond the ken of legislators, government executives, or the usual variety of businessmen.

It should be apparent that the engineer, working in close liaison with the pure scientist, must necessarily play a most important, perhaps a dominant, role in making the decisions and determining the management pattern of our future national program. The necessary background for such a responsibility will involve much more than a compilation of facts, familiarity with handbooks, facility with the slide rule, or expertness with computers.

The Formative Period

In their student days, engineers should be exposed to a substantial dose of that type of liberal education which develops a concept of what people really are and what makes them tick. Further, intensive education about people and their affairs is a continuing requirement for the engineer. He must always have more than a mere speaking acquaintance with the arts, with sociology and political science, as well as economics.

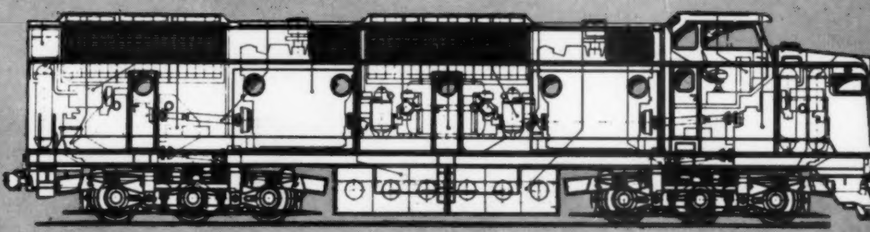


Fig. 1 Drawing of Krauss-Maffei locomotive designed for U.S. railroad applications

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Locomotive developments both in the United States and abroad during the past year have generally emphasized increased power ratings and improved adhesion control. There have been many instances of the uprating of previously developed models as well as the introduction of more highly rated new models.

In the distribution of motive-power types in the United States as of July 1, 1960, Table 1, the number of diesel units owned or leased increased by 365 as compared to a year ago, while the number of steam units decreased by 598. There were only 39 steam units in service as of July 1, 1960.

Locomotive Development Activities

No actual count of new developments is available, but the past year was one of considerable activity on the part of the builders.

Almost 1200 locomotives of various types being built under the British modernization plan are either in service or on order [1].[1] The last steam locomotive to be built by the British Railways was shipped in March, 1960 [3].

The Union Pacific Railroad is building a 4500-hp coal-burning gas-turbine-electric locomotive. The turbine to be used is being obtained by modifying one of the 4870-hp turbines used on the railroad's 51–75 series locomotives. The locomotive will be designed so that the gas turbine may be operated on diesel fuel in the event of malfunctioning of the coal-handling equipment [4].

No further information has been released in the United States on the development of atomic-energy powered locomotives, although it is reported that the Russians are studying this possibility [5].

[1] Numbers in brackets designate References at end of paper.

Report of Committee RR-6 Survey: Chairman, D. R. Meier; Members: H. G. McClean and A. G. Dean.

Contributed by the Railroad Division and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of The American Society of Mechanical Engineers. Paper No. 60—WA-289.

Note: The survey covers the period September 1, 1959, to September 1, 1960.

In Russia, it was reported that 322 two-unit diesel-electric locomotives would be supplied to the Railways in 1960. Further, a new hydromechanical-drive locomotive to rate 4000 hp at 75 mph is said to have been designed [6]. A single-unit 3500-hp gas turbine-electric locomotive, designed to burn a low-cost liquid fuel, has been built at the Kolomna Works and is being tested [7].

Design of a new Russian diesel engine is also reported in which a gas turbine is combined with the diesel to drive the supercharger and also to deliver power to the crankshaft [8]. The total net-horsepower output of turbine plus engine is said to be 3000 hp at 1000 rpm. The engine is a four-stroke-cycle type having 16 cylinders of 9.44-in. bore and 10.62-in. stroke.

The Italian State Railways have ordered 17 380-hp locomotives with hydrostatic drive. The transmission consists of two hydraulic pumps and two motors. Control is accomplished through a swash-plate mechanism [9]; 17 similar locomotives of 200-hp have been in use for a number of years.

Fiat announced a new 32-cyl lightweight diesel engine developing 2750 hp continuously at 1500 rpm [10]. The bore is 7.09 in. and the stroke 7.87 in. Dry weight is 13,000 lb. The cylinders are arranged in an X form.

In the field of electric locomotives, it is worthy of note that several locomotive builders are using silicon rectifiers for power conversion, though no details of the rectifier designs were available.

Diesel Locomotives

An outstanding development was the purchase by two Western U. S. railroads of three German-built diesel-hydraulic locomotives of 4000-hp rating [11], item 1, Table 2, Fig. 1. High-horsepower and high-adhesion

Table 1 Locomotives of Class 1 Railroads of U. S. [2]

	Diesel	Steam	Electric	Gas turbine	Total
Units owned or leased	28397	404	501	41	29343
Units stored—serviceable	450	176	62	0	688
Units awaiting repairs	1438	189	40	1	1668

Fig. 2
2400-hp four-axle
Alco locomotive

Fig. 3
General Electric 2500-hp
diesel-electric locomotive

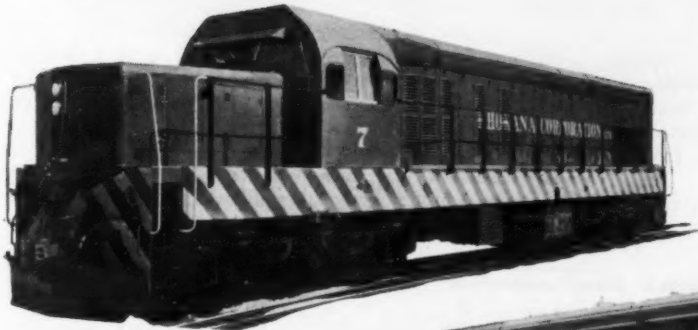
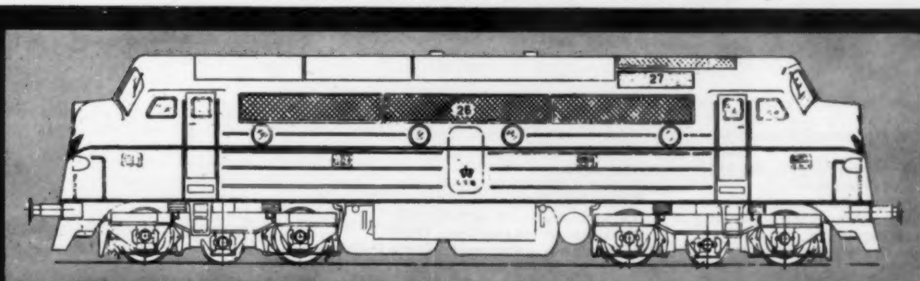


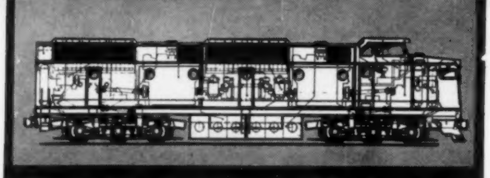
Fig. 4
General Motors-built
locomotive for Rhodesia

Fig. 5
1425-hp locomotive
for service on
Western Australian Railways

Fig. 6 Locomotive built by Nydquist and Holm for the Danish State Railways



A review of developments in railroad motive power and rolling stock, both in the United States and abroad



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capabilities are claimed for these locomotives built by Krauss-Maffei. Their performance trials on the American railroads will be watched with great interest.

Alco Products announced the production of a 2400-hp, four-axle locomotive for fast freight service, Fig. 2, item 2, Table 2. It features Alco's 16-cyl Model 251 engine, has the short end hood reduced in height to increase visibility.

General Electric introduced a 2500-hp four-axle diesel-electric unit for domestic high-speed freight traffic, item 3, Table 2, Fig. 3. All of the air for equipment on this locomotive is filtered through a static air cleaner. Electrical control is housed in a compartment below the operating cab on the side of the unit. Radiator fans are direct driven from the 16-cyl engine through right-angle drive-gear boxes. Throttle control has 16 notches instead of the usual eight. Wheel-slip control utilizes a light application of brake pressure to arrest slip.

A 1950-hp locomotive built by General Motors Corporation for the Rhokana Corporation, Fig. 4, item 4, Table 2, will be used to haul heavy ore trains in Rhodesia.

The Clyde Engineering Company has built a new model of locomotive for service on the Western Australian Railways, item 5, Table 2, Fig. 5. It is illustrated with the transfer crane used for delivery of goods from the $56^1/_2$-in-gage lines to the 42-in-gage lines.

A 1425-hp locomotive has been built by Nydquist and Holm for the Danish State Railways, item 6, Table 2, Fig. 6.

Sixteen 2300-hp locomotives being built for the Rumanian State Railways, Fig. 7, item 7, Table 2, have three-axle articulated trucks and are powered by Sulzer 12-cyl twin-bank engines.

As a result of successful operation of a prototype on the Swedish State Railways for over five years, a diesel-turbine-drive locomotive is now available as a standard model [12], Fig. 8, item 8, Table 2. In this locomotive, built by Motala Verkstad of Sweden, the supercharged diesel engine is connected through step-up gears to drive in parallel with an exhaust-gas-turbine drive. The gas turbine is further provided with combustion chambers which can be used to increase turbine output, Fig. 9. Gear shifting is done automatically.

Ninety 1400-hp diesel-electric locomotives, being constructed by several French builders for the French Railways, have the four electric motors always connected in parallel to give better adhesion characteristics, Fig. 10, item 9, Table 2.

Henschel announced that 38 1950-hp locomotives, Fig. 11, item 10, Table 2, are under construction for the Egyptian Railways. The locomotive side walls are of stressed-skin construction. The roof is especially constructed to resist tropical heat.

Electric Locomotives

An electric locomotive built by Mitsubishi will operate on 20-kv a-c or 1500-volt d-c, Fig. 12, item 1, Table 3. The power conversion is accomplished by silicon rectifiers. One motor is used for each truck, with the axles geared together.

Another Japanese locomotive, built by Hitachi for the Japanese National Railways, item 2, Table 3, Fig. 13, uses excitron mercury-arc rectifiers. Among the features

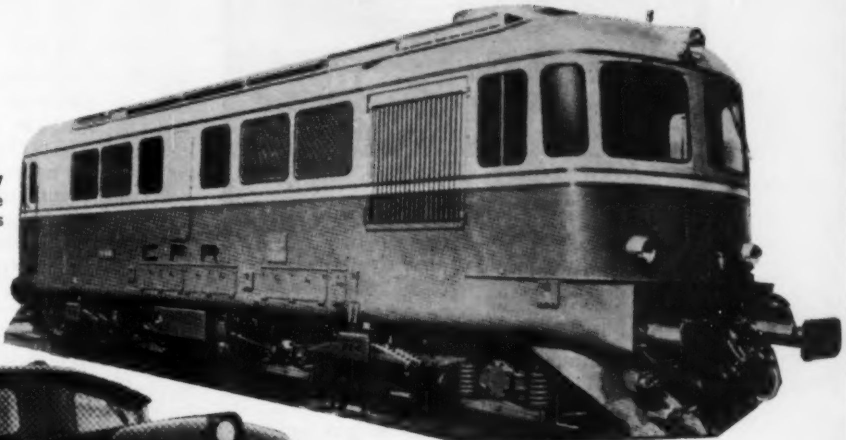
Table 2 Diesel Locomotives

Item No.	1	2	3	4	5	6	7	8	9	10
Builder—mechanical	Krauss-M.	Alco	GE	EMD	Clyde	N&HAB	Swiss LMW	AB Motala	Alst., CAFL	Henschel W
Builder—electrical		GE	GE	EMD	EMD		Brown Bov.		Alst., CEM	EMD
Owner	Southern Pacific	Alco	GE	Rhokana	WAG	Danish S.	Rumanian S.	Swedish S.	SNCF	Egyptian S.
Service	Freight	Freight	Freight	Freight	Mixed Traf.	Mixed Traf.		Mixed Traf.	Mixed Traf.	Mixed Traf.
Wheel arrangement	C-C	B-B	B-B	C-C	C-C	AIA-AIA	CO-CO	B-B	B-B	AIA-AIA
Engine data										
Engines per cab	2	1	1	1	1	1	1	1	1	1
Hp rating per engine	2000	2400	2500	1950	1425	1425	2300	1200	1400	1950
Number of cyl	16	16	16	16	12	12	12	12	16	16
Bore and stroke, in.	7.3 × 7.9	$9 \times 10^1/_2$	$9 \times 10^1/_2$	$8^1/_2 \times 10$	$8^1/_2 \times 10$	$8^1/_2 \times 10$	11 × 14.2	$7^5/_{16} \times 8^1/_4$	6.9 × 7.56	$8^1/_2 \times 10$
Engine speed, rpm	1500	1025	1000	835	835	835	750	1500	1500	835
Cycles	4	4	4	2	2	2	4	4	4	2
Supercharging	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No
Manufacturer	Maybach	Alco	Cooper-B[a]	EMD	EMD	EMD	Sulzer	AB Hede. V.	SACM-MGO	EMD
Weight on drivers, lb	288,000	255,800	256,000	216,000	194,000	140,000	224,400	136,685	154,000	194,000
Total loco. wt, lb	288,000	255,800	256,000	216,000	194,000	196,000	224,400	136,685	154,000	253,530
Fuel capacity, U.S. gal	3200	2000	1700	800	960	740	1100	528	925	1850
Driving wheel diam, in.	40	40	40	40	40	40	43.3	$38^3/_8$	43.3	42
Type of transmiss.	Hydraulic	Electric	Electric	Electric	Electric	Electric	Electric	Thermo-pneum.	Electric	Electric
Track gage, in.	$56^1/_2$	$56^1/_2$	$56^1/_2$	42	42	$56^1/_2$	$56^1/_2$	$56^1/_2$	$56^1/_2$	$56^1/_2$
Max speed, mph	70	85	92	62	62	83	62	75	65.5	74.5
Fig.	1	2	3	4	5	6	7	8	10	11

[a] Built to GE specifications by Cooper-Bessemer.

AB Hede. V.—A. B. Hedemora Verkstader
Alco—Alco Products, Inc.
Alst., CAFL—Alsthom, Compagnie des Ateliers et Forges de la Loire Fives Lille
Alst., CEM—Alsthom, Compagnie de Construction de Gros Material Electro-Mecanique
Clyde—Clyde Engineering Co.
Danish S.—Danish State Railways
Egyptian S.—Egyptian State Railways
EMD—Electro-Motive Division of General Motors Corp.
GE—General Electric Co.
Henschel W.—Henschel Werke
Krauss-M.—Krauss-Maffei
N&HAB—Nydqvist & Holm AB
Rhokana—Rhokana Corp. Ltd.
Rumanian S.—Rumanian State Railways
SACM-MGO—Societe Alsacienne, France
SNCF—Societe Nationale des Chemins de Fer Francais
Sulzer—Sulzer Bros.
Swedish S.—Swedish State Railways
Swiss LMW—Swiss Locomotive Machine Works
WAG—Western Australian Government Railways

Fig. 7
Swiss-built 2300-hp locomotive
for Rumanian State Railways



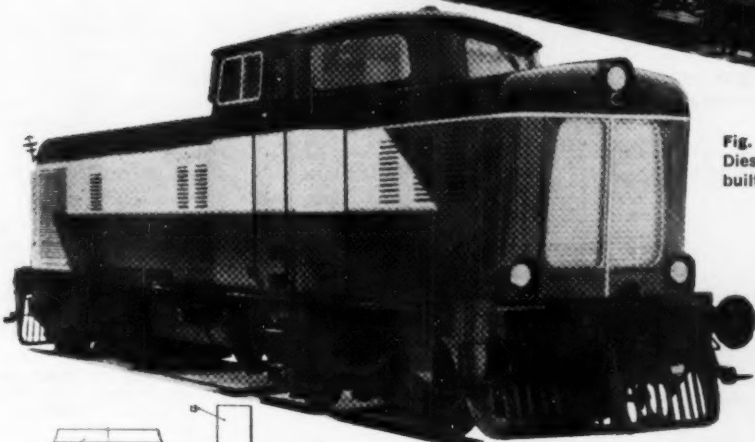


Fig. 8
Diesel-turbine-drive locomotive
built by Motala Verkstad

Fig. 9 Schematic arrangement
of drive for Motala Locomotive

1 Diesel engine
2 Step-up gear
3 Step-up gear
4 Differential
5 Compressor driving gear
6 Planetary gear retainer
7 Differential case
8 Gear on transmission shaft
9 Pinion on turbine shaft
10 Transmission output shaft
11 Compressor
12 Turbine
13 Driving wheels
14 Charge-air cooler
15 Combustion or mixing chamber
16 Induction
17 Exhaust manifold
18 Axle drive

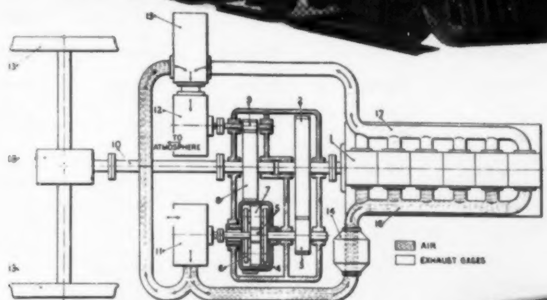


Fig. 10
Diesel-electric locomotive
for service on French Railways

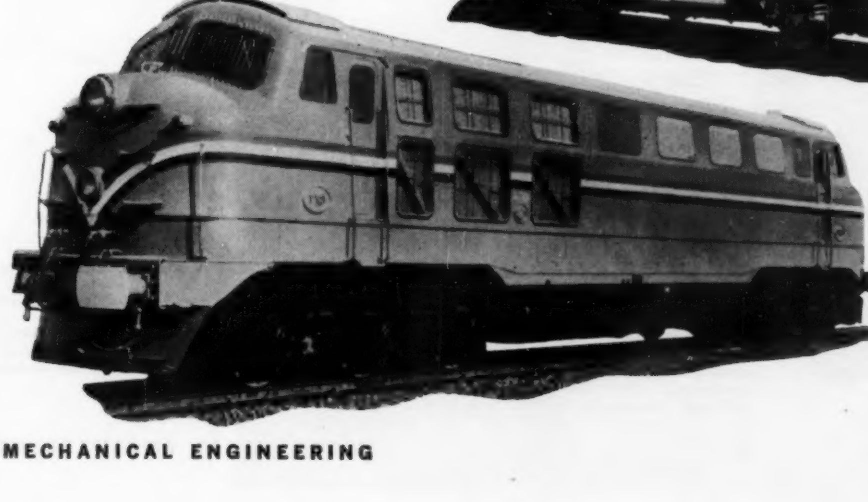
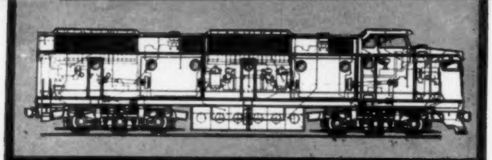


Fig. 11
Henschel-built
1950-hp locomotive
for Egyptian Railways



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provided to give improved adhesion characteristics are: (*a*) A "nearly notchless" voltage control, (*b*) a slip-detection device which flashes a warning or automatically reduces power by means of rectifier grid control, (*c*) a lower point of contact between centerplate and truck, (*d*) regulation of traction-motor field strength to compensate for weight shift.

This locomotive, although it weighs only 140,000 lb, is rated at 2500 rail horsepower continuously at 25 per cent adhesion.

Another Hitachi locomotive, Fig. 14, item 3, Table 3, is designed for passenger service on both 20-kv a-c power and 1500-volt d-c power. Only two motors are used, the axles being geared together.

Alsthom is completing an order of 100 locomotives, Fig. 15, item 4, Table 3, for the Indian Railways. In order to provide for increased reliability under high-ambient-temperature operating conditions, all electrical components are derated and an ignitron water-cooling system and air filters are used. Duplicate operating control equipment is provided on about two thirds of these locomotives.

A very heavy, powerful Swedish locomotive, item 5, Table 3, Fig. 16, intended for ore haulage, is built in three cabs weighing a total of 284 tons, and rates 7560 hp continuously.

A six-axle Japanese-built freight locomotive built by Hitachi and having a B-B-B running gear is designed for operation on 1500-volt d-c only, Fig. 17.

One of a total of 33 electric locomotives built for the British Railways is shown in Fig. 18 and described in item 6, Table 3.

Krupp has built a silicon-rectifier-powered locomotive,

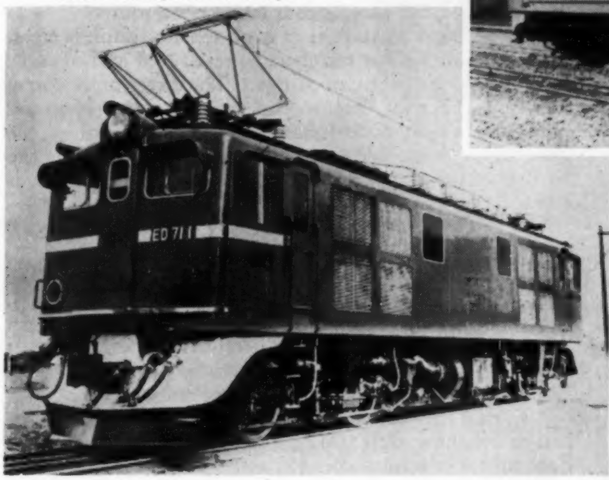
Table 3 Electric Locomotives

Item No.	1	2	3	4	5	6	7	8[a]
Builder—mechanical	MHIR	Hitachi	Hitachi	European I	NOHAB-ASJ-M	BRCW	FKME	KRS Mfg.
Builder—electrical	MEM	Hitachi	Hitachi	European II	ASEA	AEI	AEG	Hitachi
Owner	Japanese N.	Japanese N.	Japanese N.	Indian R.	Swedish S.	British R.	Deutsche B.	Japanese N.
Service	Mixed traf.	Mixed traf.	Passenger	Mixed traf.	Freight	Passenger	Mixed traf.	...
Wheel arrangement	B+B+B	BO-BO	BO-BO	B-B	1+D+D+D+1	BO-BO	BO-BO	...
Power supply	20,000 volt a-c, 60 cps 1500 volt d-c	20,000 volt a-c, 50 cps	20,000 volt a-c, 50 cps 1500 volt d-c	25,000 volt a-c, 50 cps	15,000 volt a-c, $16\frac{2}{3}$ cps	25,000 volt a-c, 50 cps	25,000 volt a-c, 50 cps 15,000 volt a-c, $16\frac{2}{3}$ cps	20,000 volt a-c, 50cps 1500 volt d-c
Power conversion, rectifier type	Silicon	Excitron	Excitron	Ignitron		Mercury	Silicon	Silicon
Current collector	Panto	Panto	Panto	Panto	Panto	Panto	Panto	Panto
Driving wheels								
Number	12	8	8	8	24	8	8	32 (4 car-unit)
Diameter, in.	$39\frac{3}{8}$	$44\frac{3}{32}$	$44\frac{3}{32}$	45	$60\frac{1}{4}$	48	$49\frac{7}{32}$	34
Weight, lb.								
Total	211,000	140,000	140,000	163,000	568,000	179,200	181,000	278,000
On drivers	211,000	140,000	140,000	163,000	501,000	179,200	181,000	158,000
Per driving axle	35,200	35,000	35,000	40,750	41,750	44,800	45,250	...
Dimensions, ft-in.								
Length, over-all	58-7	47-3	47-8	52-3	115-8	56-6	53-$11\frac{1}{4}$	...
Width, over-all	9-2	9-2	9-6	10-4	10-3	8-$8\frac{1}{2}$	10-$0\frac{1}{8}$	...
Ht, panto. down	13-11	13-1	13-1	13-8	14-9	13-0	13-$10\frac{17}{32}$	...
Rigid wheel base	...	8-$2\frac{1}{8}$	7-3	8-6	24-3	10-9	11-$1\frac{27}{32}$	6-10
Total wheel base	38-11	33-4	33-9	38-8	85-11	42-3	37-$0\frac{29}{32}$	...
Traction motors								
Number	3	4	2	4	6	4	4	8
Mounting	Truck	Axle hung	Truck	Frame mount.	Frame	Bogie mount.	Axle hung	...
Drive method	Gear	Gear	Gear	Quill drive	Coupling rods	Quill drive	Gear	Cardan drive
Gear ratio	3.88	82/15	79/20	1/4.06	25/106	29/76	20/79	17/82
Tractive force, lb (Rectified power)								
One-hour rating	42,600 (30 sec)	...	...	34,800	78,750	22,400	29,800	10,550
Per-cent adhesion	20	...	...	21	15.7	12.5	16.5	
Continuous rating	18,500	35,000	18,700	32,800	...	20,000	24,700	...
Per-cent adhesion	8.75	25	13.3	19.8	...	11.15	13.7	...
Rail horsepower (Rectified power)								
One-hour rating	1270 (30 sec)	...	...	2940	7560	3600	3700	765
Continuous rating	...	2500	1800	2860	...	3300	3300	...
Speed, mph								
One-hour rating	11.2 (30 sec)	...	...	31.7	36	59.7	46.6	27.2
Continuous rating	...	26.4	36.5	32.7	...	62.3	49.7	...
Maximum	53	59	68.3	70	47	100	75	71
Regeneration	No	No	No	No	No	No	No	No
Multiple-unit operation	Yes	No	No	Yes	No	No	No	Yes
Track gage, in.	42	42	42	66	$56\frac{1}{2}$	$56\frac{1}{2}$	$56\frac{1}{2}$	42
Fig.	12	13	14	15	16	18	19	23

[a] Electric Railcar.

AEG—Allgemeine Elektrizitöts Gesellschaft, Germany
AEI—Associated Electrical Industries, Ltd
ASEA—Allmanna Svenska Elektriska Aktie bolaget
ASW and J—Alsthom S.W. and Jeumont
BRCW—Birmingham Carriage & Wagon Co. Ltd.
British R.—British Railways
Deutsche B.—Deutsche Bundesbahn
European I—AEG, Krupp, Krauss-Maffei, Alsthom, Schneider Brugeoise-Nivelles
European II—AEG
FKME—Fried. Krupp, Maschinenfabriken Essen.
Indian R.—Indian Railways
Japanese N.—Japanese National Railways
KRS Mfg.—Kawasaki Rolling Stock Mfg. Co.
MEM Mfg. Co.—Mitsubishi Electrical Manufacturing Co.
MHIR—Mitsubishi Heavy Industries Reorganized Ltd.
NOHAB-ASJ-M—Nydqvist & Holm Aktiebolag—Aktiebolag Svenska Jarnvagsverkstaderna, Linkoping, Arlov and Falun—Motala Verkstad

Fig. 13 2500-hp locomotive for service on Japanese Railways



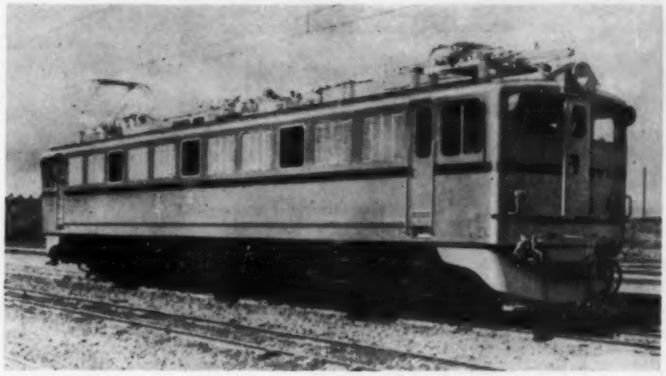


Fig. 12 Japanese locomotive using silicon rectifiers

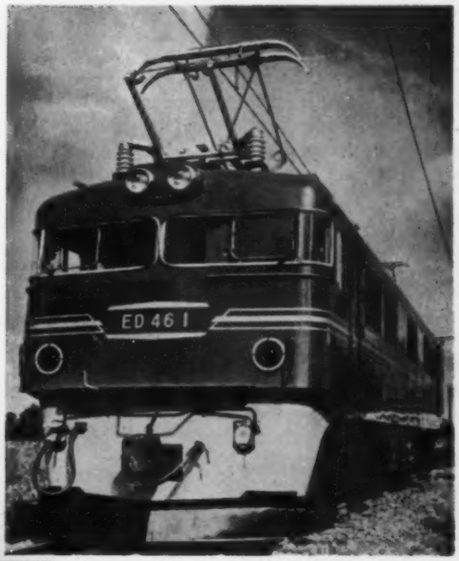


Fig. 14 Hitachi-built locomotive designed for passenger service

Fig. 15 One of 100 locomotives built by Alsthom for the Indian Railways

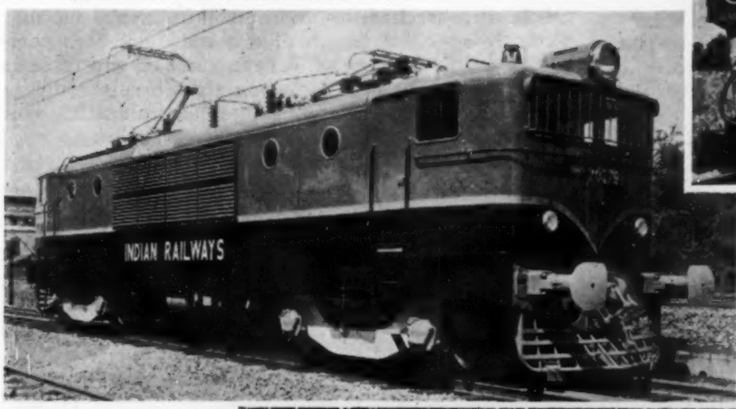
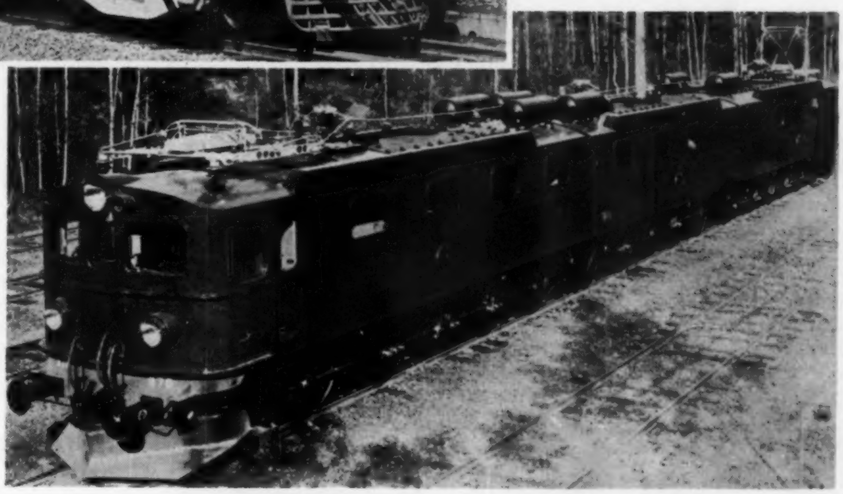
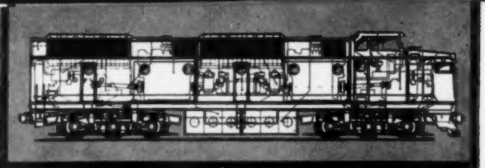


Fig. 16 Locomotive built by ASEA for ore haulage





PROGRESS IN RAILWAY MECHANICAL ENGINEERING

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item 7, Table 3, Fig. 19, intended for mixed traffic service on 20-kv, 50-cps or 15-kv, $16\frac{2}{3}$-cps overhead lines.

Item 8 of Table 3 describes a Japanese four-car train set which will be mentioned in the discussion of passenger cars.

Alsthom has manufactured 25 electric locomotives for the Chinese State Railways, Fig. 20. Except for gage, which is standard, these locomotives are the same as those built for the Russian Railways and covered in last year's report [13]. They rate 6000 hp continuously, and in two-unit operation, dynamic braking can hold a 1500-metric-ton train on a 3 per cent grade.

Passenger and Freight Cars

The construction of passenger-type equipment increased slightly over recent years. The equipment involved consisted of gallery-type suburban cars, mainline coaches, express cars, and transit-system equipment. This equipment was conventional in design and similar to that which has been covered in previous reports.

Rapid-Transit Equipment. The Chicago Transit Authority continued experiments with high-speed transit cars [14] which are regular production subway-elevated cars, equipped with 100-hp motors and geared for 73-mph top speed. Current research has been directed toward the development of moderate-cost trucks suitable for high speed. In co-operation with St. Louis Car, The Budd Company, General Steel Castings Corporation, General Electric Company, and Westinghouse Electric Company, four cars have been equipped with special trucks. St. Louis Car has built different trucks, designed by the Transit Research Corporation, Chicago Transit Authority, and St. Louis Car for two cars. Weight of the first of these truck designs is 11,620 lb. General Steel has built their most recent transit trucks having Pirelli springs in the bolster and other improved details to suit high-speed operation. This truck weighs 11,266 lb. Budd built a car set of its Pioneer III truck, arranged for rapid-transit application. Weight of the Budd truck is 10,830 lb. The different trucks have been designed with a view toward meeting the light-weight, high-speed performance requirements.

The traction equipment for two of the cars was furnished by General Electric, and for the other two by Westinghouse.

The Budd stainless-steel transit equipment, Fig. 21, for the City of Philadelphia, mentioned last year, is now being delivered. Two types of cars are being built—one permitting single-car operation, having operators' cabs at each end, and the other to operate in pairs of A and B units. The cars are 55 ft 4 in. long, 9 ft $2\frac{1}{8}$ in. wide, and 12 ft. $8\frac{3}{16}$ in. from the rail to the top of the roof ventilators. With seats transversely arranged as shown, they accommodate 56 passengers.

Each car has four 600-volt d-c motors self-ventilated with 100-hp capacity. The traction equipment, furnished by General Electric and Westinghouse, also provides for dynamic braking from top speed to approximately 5 mph. Air-operated single-shoe composition-tread brakes are provided for the final stop and emergency braking. Emergency braking is in the 3.5-mph-per-sec range with weight compensation, and acceleration is 2.75-mph-per-sec. Speed is limited to 55 mph, although gearing and power are suitable for future operation up to 66 mph. A special high-capacity ventilating system is provided, which completely changes the air in the car four times per minute.

The carbody structure is of high-tensile stainless steel, using the side sills as members to resist buff and to carry shear across the door openings. The exterior is corrugated on the roof, below the windows on sides and ends, and has smooth sheathing in the regions of the windows. A molded-fiberglass sheathing, including the formation for the ends of the roof and certain lights, is applied over the stainless-steel framing at the ends.

The single-unit cars weigh 51,400 lb and the A and B units weigh 48,600 lb each.

The Chicago and Northwestern Railway purchased 116 double-deck commuter cars for suburban service [15]. Forty-two of these cars will be equipped with control cabs at one end to permit operation of the train in either direction from the locomotive located at the opposite end of the train, without turning the train.

A similar idea is being used in Switzerland in the application of new 2800-hp electric-motor coaches [16]. Each motor coach handles 11 passenger coaches in "push-pull" operation on the Swiss Federal Railways.

A report from Europe describes the continuing development of the SAFEGE[2] overhead-suspended type of transit system [17]. This functions like a monorail, but overcomes many of the monorail problems by using a four-wheel narrow-gage truck having rubber tires and guide wheels. It runs in an inverted U-shaped supporting structure and track. The car is suspended below this truck with mechanisms to control its lateral motion. Recently a 4200-ft length of test track has been completed and a prototype car demonstrated on this track at speeds up to 40 mph including operation through a moderate S-curve. Power is supplied from a 750-volt d-c line rail to traction motors, one in each truck.

The British Railways are building eight diesel-powered trains consisting of six units each for the Western Region [18]. Four of the units are powered with two 230-hp underfloor-mounted engines, giving a total installed train horsepower of 1840.

A prototype passenger coach having pneumatic-tired wheels is being tried in Milan, Italy [19]. The system being used for guiding is a new development intended to eliminate the need for a flanged steel wheel.

The British Railways placed in service the first of five de luxe diesel-electric pullman trains for the Western Region [20]. These trains are designed for a service speed of 90 mph and are fully air conditioned and sound insulated.

Werkspoor Utrecht is building for the Netherlands Railways 15 three-car diesel-electric train sets. Propulsion power is furnished by a 16-cyl, 1000-hp Werkspoor engine. Each train set weighs 137 metric tons and is designed for a maximum speed of 125 kilometers per hr.

A new Swedish electric motor-car train, designed to operate on 15-kv, $16\frac{2}{3}$-cps power, Fig. 22, has two 230-hp motors per car. Maximum speed is 65 mph.

A Japanese ac-dc electric railcar, Fig. 23, utilizes silicon

[2] Société Anonyme Francaise d'Etudes de Gestion et d'Entreprises.

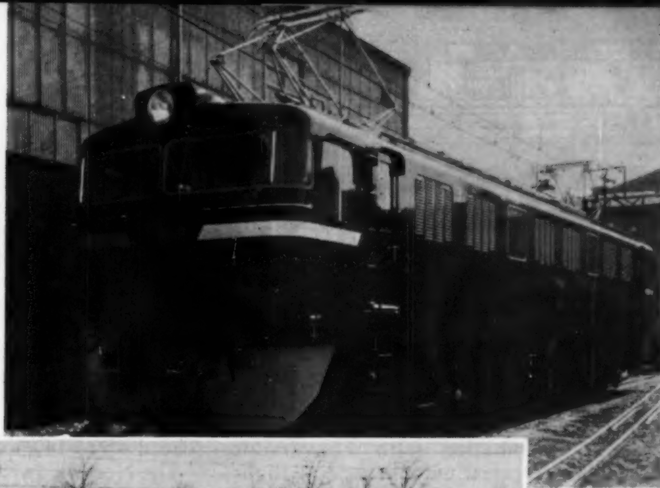


Fig. 17
Japanese-built freight locomotive
with B-B-B running gear

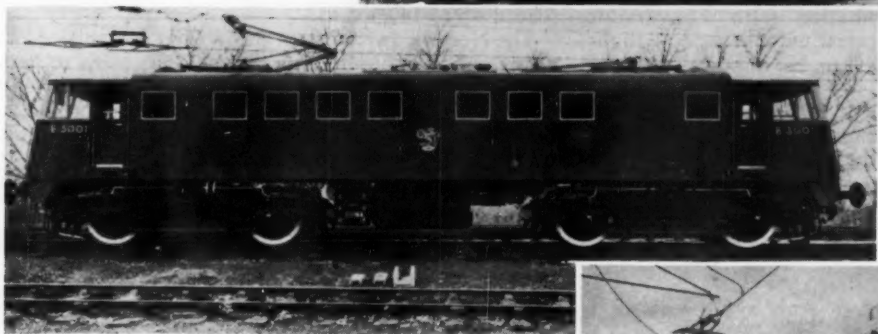


Fig. 18 British Railways electric locomotive

Fig. 19
Krupp-built
silicon-rectifier-
powered locomotive

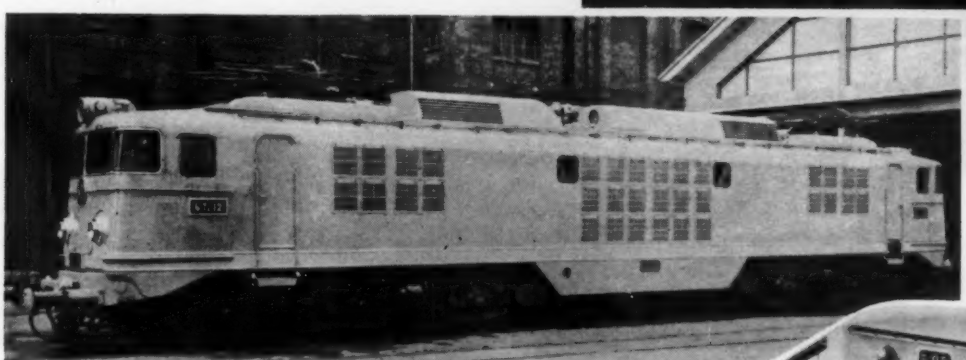
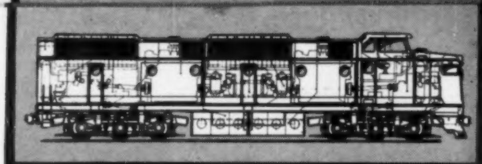


Fig. 20 One of 25 locomotives built by Alsthom for the Chinese State Railways

Fig. 21
Budd-built car
for the City of Philadelphia



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rectifiers. Power supply is 20 kv, 50-cps a-c or 1500-volt d-c. Four cars are operated as a unit.

Another Japanese railcar development uses an induction-motor drive in combination with a hydraulic coupling and three planetary-gear units in series. Eight different gear combinations can be obtained by gear shifting.

A third Japanese railcar reported uses a commutator-type a-c motor with cardan-shaft drive.

The South Australian Railways reported the development of new suburban railcars, Fig. 24, each powered by two 229-hp Rolls Royce engines. Drive is through a hydraulic torque converter.

Brown Boveri reported the placing in service of newly developed high-powered electric-motor coaches operated from 15-kv, $16\frac{2}{3}$-cps power. These coaches have a one-hour rating of 2860 rail horsepower at 15.2 per cent adhesion. They are intended for use as locomotives in helper service on heavy grades.

Freight Cars. American Car and Foundry is offering an 85-ft flatcar for use in piggy-back operation, Fig. 25. This flatcar is equipped with the A.C.F. retractable trailer hitch, combination side sill and guide rail, safety chain, and ridge plates. The light weight is about 70,000 lb and it can carry two 40 or 37-ft trailers, weighing loaded up to 140,300 lb.

The Norfolk and Western Railway in recognition of a change in coal-consumption requirements plans to build 1000 85-ton hopper cars, Fig. 26. This large-capacity hopper is intended especially for movement of coal to electric utilities, steel mills, and lake or ocean ports. The 240,000-lb gross weight is acceptable generally on the Norfolk and Western Railway and its connections. The light weight of the car is 61,000 lb.

The Pacific Fruit Express, Los Angeles Shop, is in-

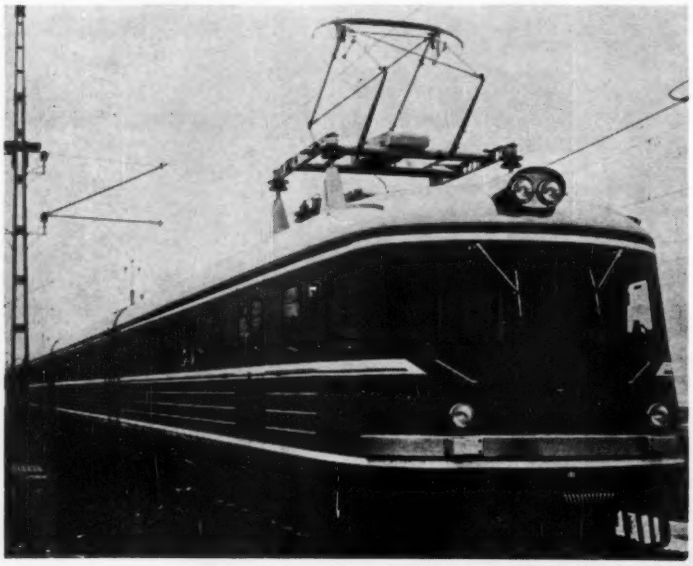

Fig. 22 Swedish electric motor-car train

Fig. 23 Japanese ac-dc railcar, equipped with silicon rectifiers

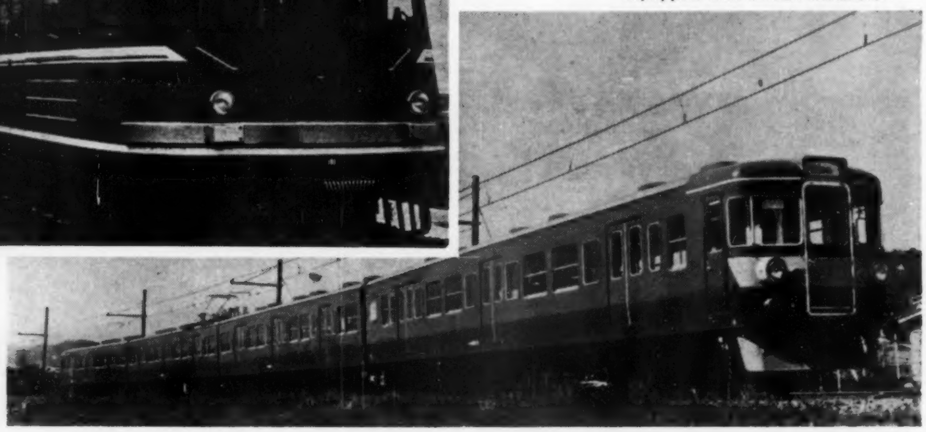

Fig. 24 South Australian Railways suburban railcar

creasing mechanical-refrigerated-equipment capacity by building 1000 new reefer cars. These are 50-ft all-purpose cars, weighing 86,300 lb light, with a load limit of 122,700 lb.

The Pittsburgh and Lake Erie Railroad has built in their own shops special-purpose freight cars for use in shipping steel-coil stock. These gondola-type cars are provided with skids or racks attached to the car by shock-absorbing means and covered with a removable corrugated-steel hood. They will handle steel coils up to 7 ft in diam and weighing 35,000 lb. The hoods are insulated and vented for all-weather protection. They have demonstrated an excellent record for freedom from damage during shipment.

Pullman-Standard has built a special car for transportation of automobiles. This car, intended specifically for Frisco Lines, is 85 ft long, having three loading decks, giving a loaded height of 18 ft 4 in., Fig. 27. Loading ramps are provided to permit driving the automobiles to the desired deck.

Pullman-Standard has also developed a Hydro-Frame car, for use as a container-transporting car, or as a boxcar. The container car, Fig. 28, consists of standard trucks and a boxcar center sill on which is mounted a container frame with a long-travel hydraulic cushion. This cushion provides 30 in. of shock-absorber action in either direction between the container frame and the center sill. It is stated that acceleration of the container is limited to 1 g at 10-mph impact speed.

The Hydro-Frame 60 boxcar is an essentially standard 50-ton boxcar mounted on a similar underframe, Fig. 29, providing 30 in. of longitudinal movement between the center sill and the car.

The Union Tank Car Company has built two railroad tank cars of 30,000-gal capacity for transportation of liquefied petroleum products, Fig. 30. These cars are 85 ft and $^1/_4$ in. over coupler pulling faces, 14 ft $7^1/_{16}$ in. high and 9 ft 6 in. wide. The maximum loaded weight is 251,000 lb and the light weight is 108,000 lb. The underframe is integral with the tank. It is carried on 100-ton-capacity Barber S2A trucks equipped with $6^1/_2 \times$ 12-in. heavy-duty Timken Roller Bearings.

The Southern Railway System has developed a special-purpose car, Fig. 31, for transporting lumber. It is a 70-ton, 42-ft 8-in. boxcar, whose sides are made of two roll-up doors per side, with an intermediate hinged post.

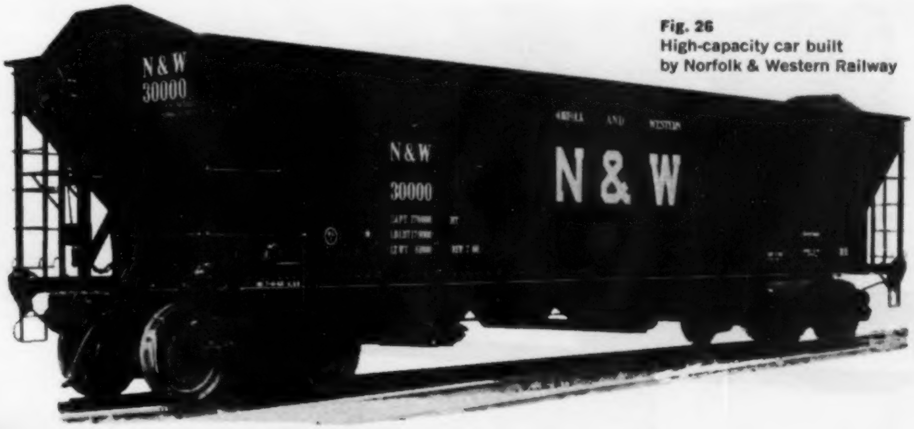

Fig. 26
High-capacity car built by Norfolk & Western Railway

Fig. 25
85 ft flatcar for piggy-back service

Fig. 27
Automobile transportation car for the Frisco Lines

Metal stakes along the side sills prevent shifting of the load against the doors. The car is quickly loaded or unloaded by opening the entire side.

One of the 1200 hopper and gondola cars, with bodies of Reynolds Aluminum, being built by Pullman-Standard and Magor Car Corporation, is shown in Figs. 32 and 33. Data on the capacity of these cars were given in last year's report.

Freight-Car Accessories. The Aluminum Company of America has developed a lining of tongue-and-groove extruded aluminum which has been recently installed in 50 boxcars of the Baltimore and Ohio Railroad. Weight of the panels is 1500 lb per car which is slightly greater than the wood they replaced.

The Alton & Southern Railroad has placed in service 10 boxcars equipped with multileg nailable aluminum floors, fabricated of extruded aluminum by the Aluminum Company of America. These floors will save 1380 lb over 10-gage steel floor in a 40-ft car and 1720 lb in a 50-ft car. It is expected that maintenance will be reduced.

The Reynolds Aluminum Company announced the availability of aluminum doors, inner liners, and roofs made of aluminum alloy. An 8-ft door weighs 312 lb compared to 562 lb for an 8-ft steel door. The inner liners are intended for upgrading old freight cars. The weight of the roof is 890 lb for a 40-ft car as compared to 1680 lb for the equivalent steel roof.

The Bethlehem Steel Company is offering a composite wood and steel floor, Fig. 34, consisting of alternate wood planks and steel hat sections, which produce a flat floor with the combined strength of the steel transverse hat sections and the nailability of the wood strips.

The Barber cushion-tube underframe arrangement, manufactured by the Standard Steel Car and Truck Company, provides for increased draft-gear travel by

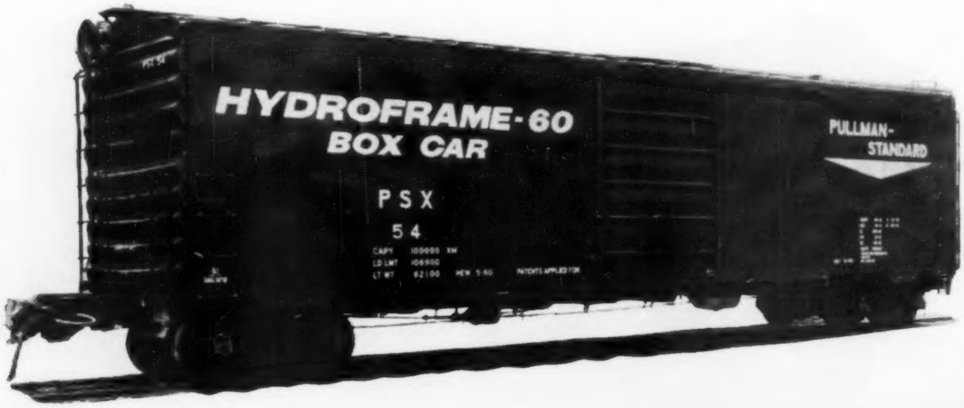

Fig. 29 Boxcar mounted on cushion underframe running gear

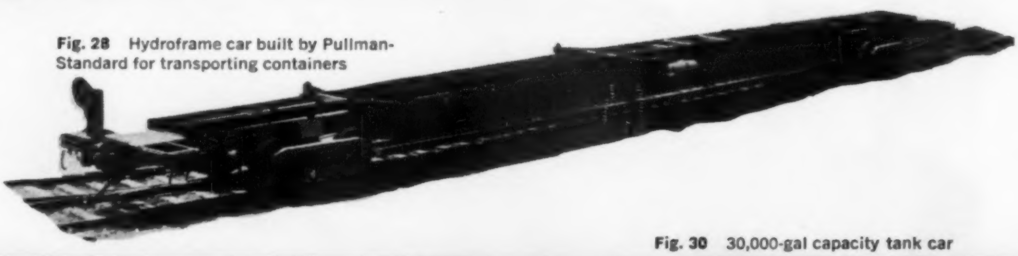

Fig. 28 Hydroframe car built by Pullman-Standard for transporting containers

Fig. 30 30,000-gal capacity tank car

combining the travel of both standard draft gear. This is accomplished by means of a long cushion tube supported within the center sill and having each end in contact with the standard draft gear. Draft gear and tube act in series to produce a struck-coupler travel of two times the travel of one gear, plus the compression of the cushion tube. In draft, the tube is inactive and each gear acts as it normally would in a conventional car.

The Standard Railway Equipment Manufacturing Company provides movable bulkheads for use in gondolas. They are of welded construction 6 in. deep, with a corrugated, semihoneycombed core covered with $^3/_{16}$-in. sheets.

Youngstown Steel Door Company introduced a new concept in freight-car doors, combining one regular and one "plug" door on each side of a boxcar to permit more complete car utilization. With the plug door closed, the shipper can place loads against it because it is flush with the inside wall. With both doors opened, the shipper has wide opening for long loads and for fast mechanical handling of packaged or palletized loads by fork-lift trucks.

Acknowledgments

The Committee on Survey wishes to express its appreciation for the assistance extended by trade magazines, and the railroads, locomotive and car builders, and equipment suppliers in making information available.

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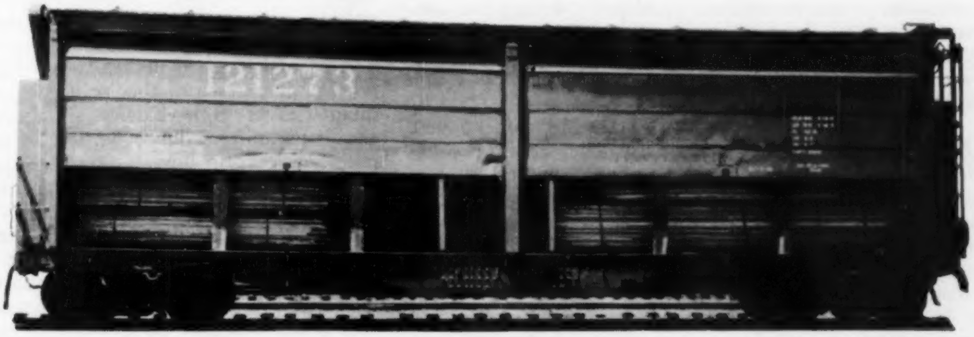


Fig. 31 Car especially designed for lumber transportation

Fig. 32 One of 1200 aluminum-body cars for Southern Railway

Fig. 33 View inside

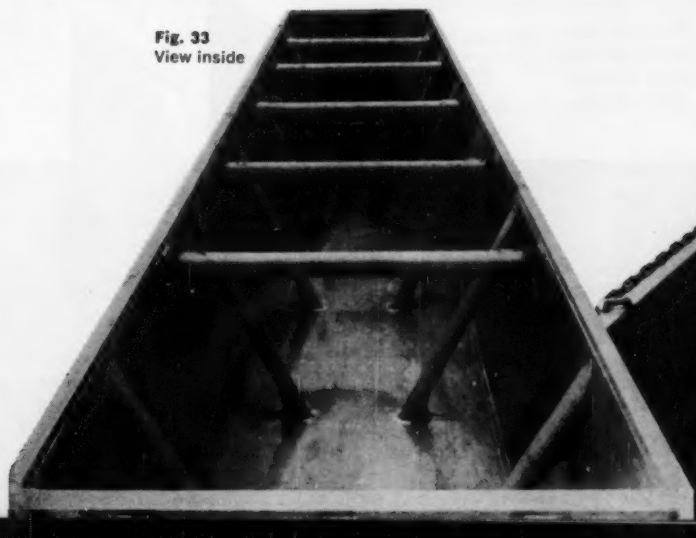


Fig. 34 Composite floor developed by Bethlehem Steel Company

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Associate Editor

BRIEFING THE RECORD

Hovertrucks and Hovercoaches

THE HOVERCRAFT—the wheelless vehicle which glides on a cushion of air—has demonstrated its ability to operate in prototype (MECHANICAL ENGINEERING, August, 1959, p. 79), and has entered the product-development stage. Vehicles which can operate over rough, unprepared surfaces have been selected as most promising commercially. Undeveloped areas, oil fields where vehicular access is required principally during the construction stage, and swampy regions are regarded as a prime market. Hoverways from which major obstacles were removed could be constructed simply by rough bulldozing.

An article by Derek Harvey in the November, 1960, *Hawker Siddeley Review* outlines the developmental problems in attaining adequate hover heights in contrast to the relatively thin cushion of air used in smooth-surface applications. It describes alternate power plants which would overcome the awkward, nearly circular configuration dictated by the present method of building them around a large-diameter fan.

Essentially, there are two ways of forming the all-important cushion. It may either be produced by pumping air into a self-contained space or plenum chamber under the vehicle and allowing it to leak out near the ground around the periphery (several smooth-surface hovercraft have been built on this principle in the United States, MECHANICAL ENGINEERING, February, 1959, pp. 82–83; July, 1959, p. 66), or, alternatively, an annular jet of air may be ejected downward and inward at relatively high speed all around the edge of the vehicle to form an invisible curtain. This traps the cushion, which is itself formed by the momentum change in the curtain air as it is forced to turn and move outward after leaving the periphery nozzles. This has been found to be a much more efficient method of attaining realistic hover heights and it has been adopted in all the designs by Folland Aircraft Ltd., one of the Hawker Siddeley Group Companies.

To overcome the circular configuration, Folland has been testing a number of air-compressing systems which would locate the entire curtain-producing system outside the loading area, around the periphery of the vehicle. The curtain air would be recirculated as a vital means of reducing the pressure rise needed through the compressor and hence of operating at greatly reduced power and correspondingly improved economy. One system consists of a flexible train of blades, carried on a series of rollers or sprockets around the outer edge of the vehicle in the form of a moving cascade, which pumps the air through continuous ducts. This scheme is equally well suited to rectangular or to oval-shaped hulls and is better able to withstand impact damage than the rigid large-diameter fan.

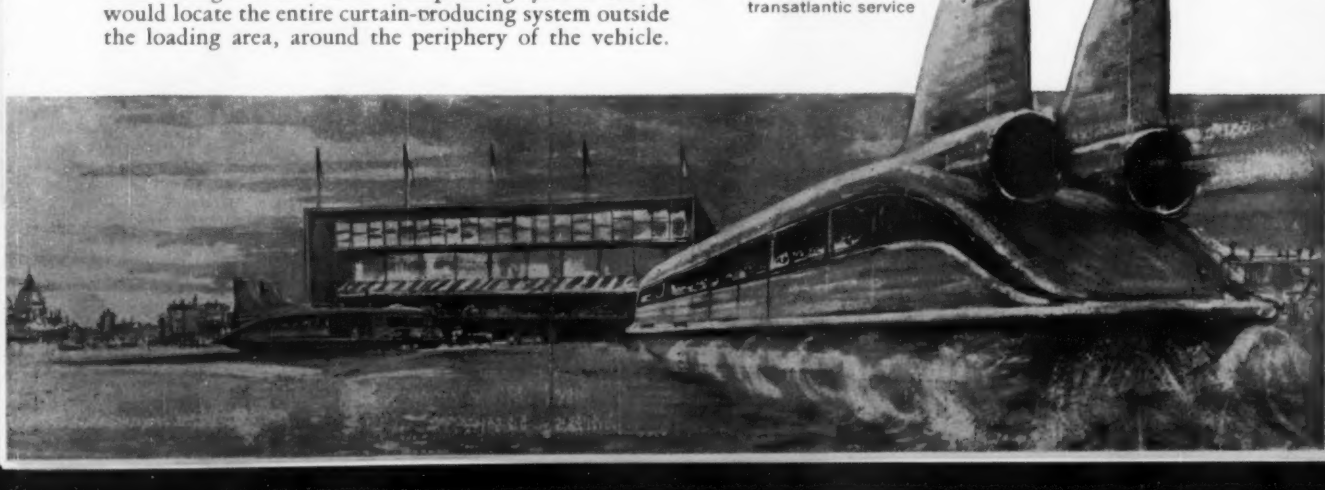
A second method makes use of a peripheral injector, which operates on the principle of injecting small quantities of high-velocity air through narrow slots, thus entraining a large volume of air to produce the necessary curtain flow. Attractively simple in theory, the system poses a number of problems in design and manufacture on a large scale.

The third method consists of a series of small high-speed fans, disposed around the outer edge of the vehicle and linked by flexible drives to the main power plant. A major advantage of this arrangement is the ease with which the fans may be serviced, or replaced in the event of damage. Such a scheme would appear to require less development than the other two and also represents a means of employing the same lifting system for various sizes of vehicle.

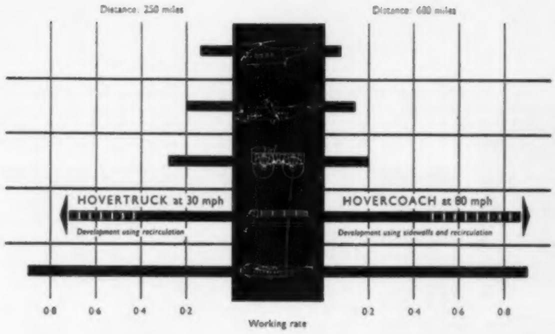
Using any of these systems, adequate hover heights can be attained on thrusts amounting to as little as one-tenth the weight of the vehicle.

An independent system will be necessary in most cases for propulsion and for the more critical case of maneuvering.

Various types of power plants have been considered. Multiple fans can conveniently be driven either by a reciprocating engine or by a gas turbine. The latter



The ultimate goal of Hovercraft development is use for high-speed cross-channel ferries or for transatlantic service



Working rates for various types of transport. Working rate = tons payload per hp × mph, and can be considered as the load moved for a given cost per hr over a stipulated distance.

would be used mainly for larger vehicles of over 20 tons, where high power outputs are required at weights far below the best that can be achieved at present, even by the lightest piston engine. For the ejector system, a large supply of pressure air is required and this appears to combine very well with the idea of using a turbine-powered gas producer, such as the Bristol Siddeley BS53—again for the larger size of vehicle.

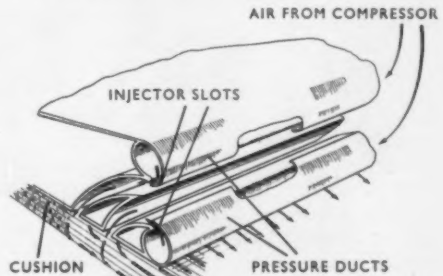
To avoid risking the future of the Hovercraft type of vehicle with overambitious projects on the scale of transatlantic or cross-channel ferries, smaller vehicles are being designed to acquire practical experience. One in the design stage is a Hovertruck, intended as a utility vehicle and capable of carrying mixed loads of up to 5 tons over unprepared roads, rough ground, and across water. Absolute reliability, with a minimum of maintenance and repairs that can be performed by comparatively unskilled labor, are primary criteria.

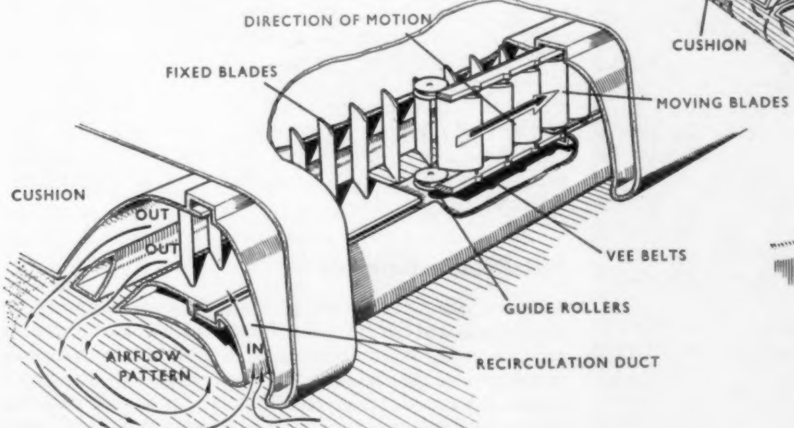
While it has been calculated that the use of hovercraft will lead to slightly higher direct operating costs in terms of cents per ton mile than with any single conventional method of surface transport, it should show a very large saving on cross-country journeys to the nearest railhead or loading dock even if the lack of road-resurfacing costs is not taken into account.

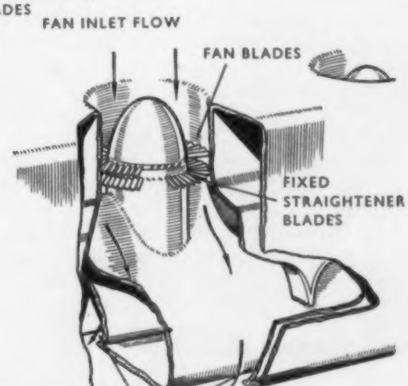
The Hovertruck is designed to operate at speeds up to 30 mph over land or across reasonably smooth stretches of water and, if necessary, it can carry sufficient fuel for a full day's work. The hovering height selected for this particular vehicle is an economic compromise between excessive power requirements and lack of effective mobility, since doubling the hovering height would either halve the payload that could be carried or would take twice the power to achieve.

There is also a need for a larger and more sophisticated vehicle. In many areas of the world, coastal passenger and freight traffic is made difficult and uneconomic by local geographical conditions. There are, for example, many cases where towns and villages situated on coastal inlets or inland waterways could conveniently be served by high-speed amphibious craft. A large coastal vehicle, capable of carrying 150 passengers or 20 tons of freight, is envisioned. Its internal accommodation would be similar to that provided in existing long-distance trains and road vehicles, with an alternative application as a car ferry. A cruising speed of 80 knots (over 90 land miles per hr) would be possible with an operating range of 600 nautical miles allowing a full day's operation without refueling.

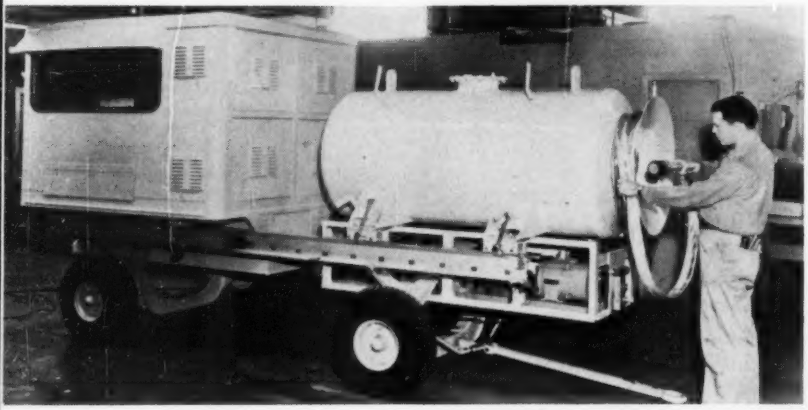
Probably the best way to compare these vehicles with other forms of transport is in terms of their rates of working. These can be expressed as tons-per-hour, that is, the product of load-carrying capacity and speed—or the amount of load that can be moved in a given time for a given amount of power. A comparison on this basis is made in the diagram.



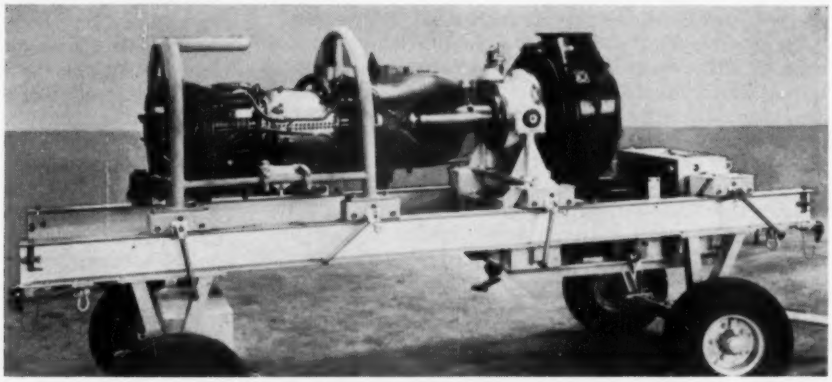




Three proposed methods of air compression: **1, Above,** a flexible train of blades, carried on a series of rollers or sprockets, forms a moving cascade which pumps the air through continuous ducts. **2, Top, right,** small quantities of air are peripherally injected through narrow slots, thus entraining a larger volume of air to produce the necessary curtain flow. **3, Bottom, right,** a series of small high-speed fans around the edge of the vehicle is linked by flexible drives to the main power plant.



Components of the mobile test cell developed for the U. S. Navy to test GE's T58 turboshaft engine are mounted on two trailers. Instrument control cab and fuel system are on a 152-in-long rail trailer. Engine being tested and load-absorption device are on a 130-in-long trailer. The engine is attached mechanically to the load device, compressor section of a GE CH-7 turbosupercharger, to simulate load. With the equipment, post-maintenance tests can be conducted in the field rather than at semipermanent installations.



Mobile Turboshaft-Engine Tester

A MOBILE test cell capable of being airlifted to any part of the world has been developed for the U. S. Navy by the General Electric Company. It is designed for post-maintenance field testing of G-E's 1250-hp T58 turboshaft engines which power two Navy turbocopters —the Sikorsky HSS-2, and the Kaman HU2K.

The portable system will provide virtually complete engine-test capability at maintenance bases around the world without requiring engines to be shipped to semi-permanent facilities for this type of testing. The system is also less costly than present methods.

A major refinement is the use of a turbosupercharger compressor section as the load-absorption element. Unit used is the G-E CH-7. Load on the test engine is simulated by mechanically attaching it to the supercharger. Load is varied by adjusting a special lenslike orifice covering the supercharge air intake.

The unit is assembled on two trailers. An instrumented control cab and fuel system are mounted on a 152-in-long rail trailer. On a 130-in-long rail trailer is the test vehicle and load-absorption unit with its related systems.

Turboshaft engines up to 1500-hp can be tested on the new equipment. By using a larger compressor section, engines up to 3000-hp can be checked.

Gas-Turbine Hydrofoil

Two SEAGOING small gas turbines built by the Garrett Corporation's AiResearch Manufacturing Division, Phoenix, Ariz., will start and supply electricity for a new 104-ft-long hydrofoil boat capable of 80 knots on the open seas. It is being built for the U. S. Maritime Administration by Grumman Aircraft's Dynamic Developments.

Scheduled for launching early next spring, the 80-ton, all-aluminum hydrofoil will use two AiResearch GTCP 85-91 turbines equipped with special, light aluminum housings. These units will pneumatically start the aircraft-type turbine prime mover which skims the craft through the water on two sets of foils.

Once their task of spinning the main jet power plant to life is completed, the turbines will generate all the electrical power needed to operate the boat.

Based on Grumman's experience in building amphibious aircraft, the boat relies extensively on aircraft-type construction. In operation, a set of foils in the water just forward of the craft's center of gravity will "fly" the boat hull above the water. Another set of smaller water-foils well aft provide stability and high-speed maneuverability.

Pedalless Automobile

REPLACING pedals with pressure-sensitive segments of the floor board for both acceleration and power braking reduces driver response time in a pedalless automobile developed by the Products Division of the Bendix Corporation. Variable-ratio steering, a "split system" for hydraulic brakes, and a new "constant-velocity" universal joint are other innovations recently demonstrated by the company at the annual meeting of the Society of Automotive Engineers in Detroit.

The floor board on the driver's side of the car is divided into two wide segments which move slightly when the driver applies pressure. The left segment which con-

Foot pedals are replaced by pressure-sensitive areas of the floor board for braking and acceleration in a new pedalless automobile design. Driver response time is reduced because feet do not have to be shifted and foot thrust is shorter, resulting in greater safety.

trols the brakes moves only $^1/_8$ in. and the right segment for the accelerator $1^1/_8$ in. compared to conventional movements of 3 in. to full throttle or 6 in. for braking. Firmness is provided to reduce oversensitivity and approximately the same foot pressures are required as for conventional controls. When the power braking provided by a 2000-psi accumulator fails, additional foot pressure will bring a standard master cylinder into operation. A further safety factor is the provision of separate hydraulic lines for the front and rear brakes to prevent a line rupture or leak from throwing out the whole braking system.

The Varamatic steering system reduces the number of turns required for parking or maneuvering by 60 per cent, yet provides a firm, safe steering-wheel "feel" during high-speed driving. The 22:1 ratio between steering-wheel turns and front-wheel angle decreases as the steering wheel is turned, but remains constant in standard steering.

The Bendix universal joint is expected to solve many of the problems encountered in building front-wheel-drive automobiles. In the standard rotational joint the rotational speeds of the shafts vary and set up vibrations in the system. These cause wear and stress on bearings, gears, and other components of the power-transmission system. The "constant-velocity" design of the Bendix unit provides assurance that the driving shaft and the driven shaft will turn at the same speed and will eliminate vibration, according to the engineers. In addition, the design offers "rolling-end" motion, which eliminates the need for splines.

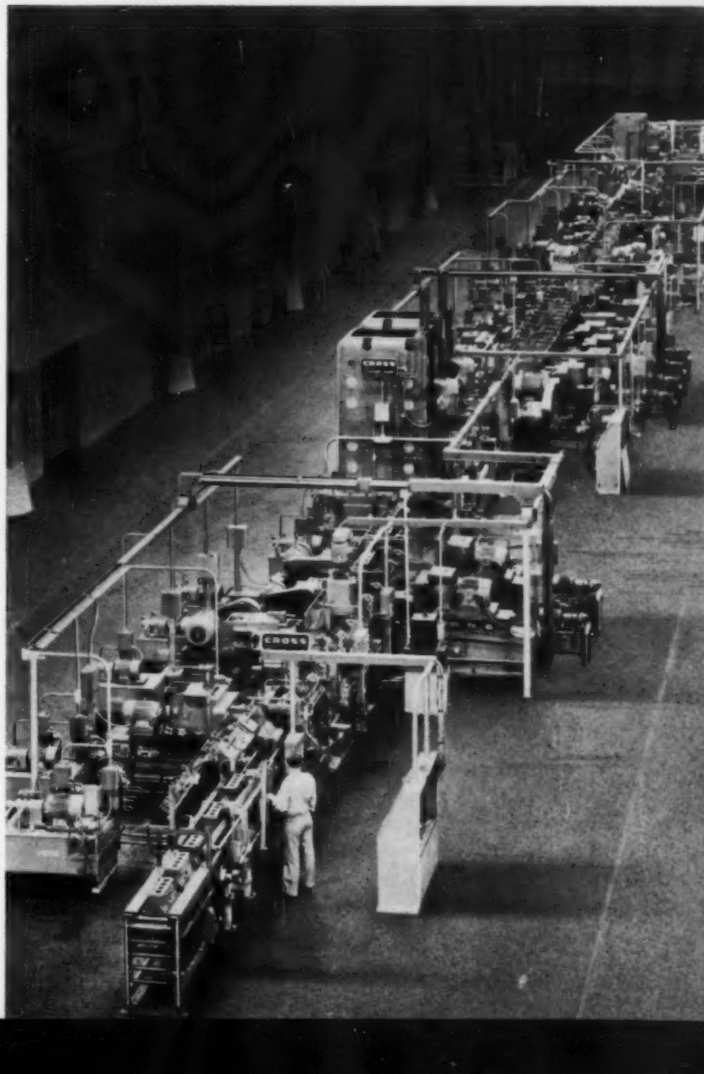
Six-Section Transfer Machine

ALL milling and cylinder boring are integrated with assembly and the many other operations required to finish cylinder blocks for four-cylinder engines in a new Transfermatic machine, designed and built by the Cross Company, Detroit, Mich. The machine also makes possible uniform standards.

The machine consists of six major sections. Briefly, cast-iron blocks, with their tops and bottoms broached, are loaded in Section 1 where heavy metal-removing operations are performed. In Section 2, ends of the blocks are milled and cam bores are roughed. Following a banking conveyer, blocks enter Section 3 where their sides are machined. Section 4 includes operations for drilling and tapping holes on the top and bottom of the blocks, and finish reaming the tappet holes. After they emerge from a washer, blocks enter Section 5 for bearing-cap assembly. In Section 6 the cam and crank bores are machined.

To process these blocks requires establishment and finishing of 123 assorted holes and several surfaces. Cycle times of the various sections of this Cross Sectionized Transfermatic are different but, through banking conveyers, the line balances out to a production of about 85 blocks per hr. The line maintains high block accuracy, and its design is sufficiently flexible to accommodate block-design changes.

A six-section transfer machine integrates all of the operations required to finish cylinder blocks for four-cylinder engines. Establishment and finishing of 123 assorted holes and several surfaces are required. Cycle times of the various sections are different but balanced out to produce about 85 blocks per hr.



Electrolytic Machining

An electrolytic machining process that can shape parts from the toughest alloys in as little as one-tenth the time of conventional machine tools has been developed by Battelle Memorial Institute in research supported by the Steel Improvement and Forge Company of Cleveland.

Metal is removed without arcs, sparks, or high temperatures by passing direct current between the workpiece and an electrolyte. The current removes electrons from the workpiece, converting the surface atoms into positively charged ions that dissolve into the electrolyte. This process is unique in that its effectiveness is not dependent on the hardness of the metal and, thus, offers a solution to the problem of machining the harder, higher-strength metals.

To produce a part, a rough forging or piece of metal stock (anode) is placed between shaped electrodes (cathode) and electrolyte is pumped under pressure into the space between the electrodes and the workpiece. As the electric current dissolves the workpiece to the desired shape, the electrodes are moved in simultaneously.

The electrolytic unit has machined roughforged jet-turbine blades to 0.003-in. tolerances in 5 to 10 min—an operation which took from 1 to 2 hr to perform by grinding. In addition to shaping parts, other types of units can be used to sink die cavities in 50 min which previously required 7 to 10 hr of machining time. Round and irregularly shaped holes can also be drilled in alloys that cannot be penetrated by conventional drills. For some applications the process's big advantage is not the time saved but the absence of mechanical damage to the surface of the workpiece.

Because there is no tool pressure on the workpiece, very thin sections can be shaped without deformation and lightweight machines and clamping systems can be used. Also, the shaping process produces no metallurgical change on the surface of the workpiece as conventional machining does.

The electrolytic machining process was developed by a Battelle research team which included Charles L. Faust, chief of electrochemical research at Battelle; John A. Gurklis; and John E. Clifford.

According to Dr. Faust, the Battelle-developed process differs from others which use the electrolytic-metal-removal principle in that: (*a*) It can produce complete parts in addition to sinking cavities, (*b*) it uses no rotating cutting wheels, (*c*) power is supplied through a simple rectifier instead of complex electronic circuits.

Current requirements for the electrolytic-machining process range up to 1500 amp per in. of workpiece at 3 to 12 volts, to achieve a penetration rate of 0.05 to 0.1 ipm. However, for most operations a 100 to 500-amp current is sufficient. The shaped electrodes, which are not subject to wear, can be made of any electrically conductive material. The electrolytes, selected according to the metal to be machined, are solutions of readily available commercial chemicals.

Linemen work barehanded on a 34,500-volt line. They stand in nonconducting fiberglass buckets supported by an insulated boom. Protected by insulation from the difference in voltage between the ground and wire, they are charged at line voltage by connecting the buckets' metal-mesh lining to the wire.

Human "Birds"

Linemen of the American Electric Power System now work bare-handed on live high-voltage lines, thanks to a new twist on an old idea borrowed from the birds who perch on high-tension wires with impunity.

The system has been thoroughly field tested and is about to be adopted as standard practice. AEP President Philip Sporn, Hon. Mem. ASME, warned that its use requires special equipment and proper training to insure the linemen's safety.

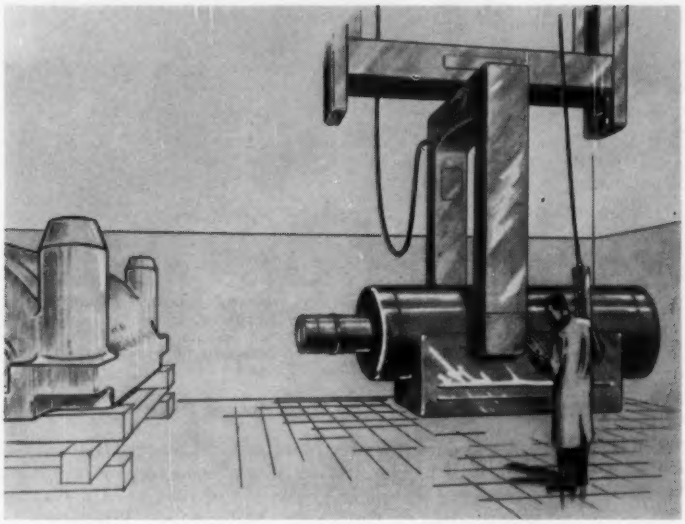
The principle is utilized that current does not flow when there is no difference in voltage between two points. Linemen were previously grounded and insulated from the live conductor by protective devices such as rubber goods and insulated hotsticks. With the new method, a lineman is charged at the same voltage as the line on which he is working— a phenomenon of which he is not even physically aware—and protected from ground by effective insulation.

Linemen work while standing in a fiberglass bucket hoisted to overhead wires by a truck-mounted insulated aerial boom. The bucket is lined with metal mesh that is connected by clamps to the conductor on which the men are working, thus energizing the screen and the occupants at the same voltage as the line. Their safety is provided by the insulated boom which protects them from the difference in voltage between the ground and the live conductor.

It is no longer necessary for linemen to work with special tools attached to long insulated poles, while hanging from wooden poles or steel towers by their safety belts.

Savings in time will be major. For example, the time required to change an insulator on a 34,500-volt wood-pole line has been reduced from five manhours to half a manhour.

Holan Corporation, Cleveland manufacturer of hydraulic derrick trucks and aerial lifts, and its parent company, the Ohio Brass Company, co-operated in the tests and supplied equipment. The lab work was carried out in the Ohio Brass High-Voltage Laboratory at Barberton, Ohio.



An 8-Mev linear accelerator, designed for x-ray inspection of steel more than a foot thick, can be raised from floor level to a height of 16 ft, tilted at any angle from vertically downward to 45 deg upward, and may also be rotated in the horizontal plane

"Linac" X-Raying

An 8-Mev linear accelerator specifically designed for 600-roentgen per min radiography in the metals industry is being built for the A. O. Smith Corporation's Milwaukee, Wis., plant by the High Voltage Engineering Corporation of Burlington, Mass. The linear accelerator, or "linac," is designed for x-ray inspection of steel more than a foot thick.

The linac differs from conventional radiographic equipment in that it produces its x rays by "firing" high-energy electrons in a straight line down an evacuated tube. The electrons are impelled by traveling radio-frequency waves at speeds approaching those of light, or 186,000 miles per sec. At the end of the tube, the electrons strike a tungsten target and produce penetrating x rays which are beamed upon the material.

The project will cost $700,000 when completed and is part of the Atomic and Process Equipment division's $4-million long-range expansion program.

Automatic Nail Packaging

Automatic packaging of nails with a system that is being adapted to the packaging and handling of other elongated or sharp metal objects as well as free-flow materials, including items as diversified as screws, bolts, shotgun shells, and even detergents, has been developed by the Mead Corporation, Cincinnati, Ohio.

A conveyer automatically collects and weighs 50 lb of nails. As they fall down a chute they are aligned horizontally by electromagnetic machinery developed by the Dake Corporation, Grand Haven, Mich. Polarity is then reversed and the nails fall ranked rather then helter-skelter into a new type of package.

This is a heavy-duty corrugated paperboard carton with three plies on its bottom, and two on its four sides. The package, folded into shape from a single corrugated blank, includes a spout for pouring nails. It seals tightly to protect the contents from moisture and rusting.

This system eliminates the use of a vibrator which was commonly used to shake down the conventional tangle of nails to make them fit into a container which often took 13 min. The noise of the operation also impaired the efficiency of employees who worked nearby. In addition, nails sometimes worked their way between the liner and the corrugations, puncturing both.

With the new system, puncturing does not occur, and cost of packaging has been reduced as much as 50 per cent, amounting to up to 20 cents per case. The unavoidable air space found at the top of the carton and which impaired "stackability" has been eliminated.

Sea-Water Conversion Plant

A construction contract for a 1-million-gpd plant was awarded by the U. S. Department of Interior's Office of Saline Water to the Westinghouse Electric Corporation.

The plant, one of five demonstration plants to be built by the office of Saline Water (Mechanical Engineering, September, 1959, p. 71; October, 1960, pp. 57–62), will be located at Point Loma near San Diego, Calif. Its daily output of 1-million gal of fresh water will be purchased by the city of San Diego.

The Westinghouse heat-transfer department will have full responsibility for the construction and startup operation of the Plant. A multistage flash-distillation system will be used to convert the sea water into fresh.

The architect-engineering services were handled by Fluor Corporation, Ltd., of Los Angeles. The Ralph M. Parsons Company of Los Angeles will participate in the engineering and construction of the plant. Construction is scheduled for completion in one year.

Westinghouse will operate the plant for a shake-down period of 75 days, including 30 days at the full daily output of 1-million gal. Once in operation, it will be the largest multistage flash-evaporator plant in the U. S.

Westinghouse has a long record of experience in this field, including a large installation in Kuwait on the Arabian Penninsula (Mechanical Engineering, April, 1960, pp. 84–85), where four multistage flash-evaporation units now supply over 2.5 million gal of drinking water a day from Persian Gulf sea water. The units in this plant have been in constant operation since 1957.

"Hole Machine"

A SPECIAL machine designed, built, and employed in full production by the Microbore Division of DeVlieg Machine Company, Royal Oak, Mich., eliminates the use of numerous mathematical calculations, extensive application of instruments and gages, and time-consuming cross-checking work, yet pinpoints locations for boring operations quickly and accurately.

A single "fix" from the gage line or face of a boring bar enables the DeVlieg machine to hold all subsequent hole dimensions required in a bar automatically—closer than 0.001 in.—whether the holes are straight, angular, or reverse angular.

The "hole machine," as it is called, will handle bars of all types (straight, NMTB tapered, stub, flanged Heald, Ex-Cell-O, and many types of turret-lathe bars), accurately locate and machine the proper holes (for Microbore cartridges) to accommodate any combination of single or multiple precision-tooling applications.

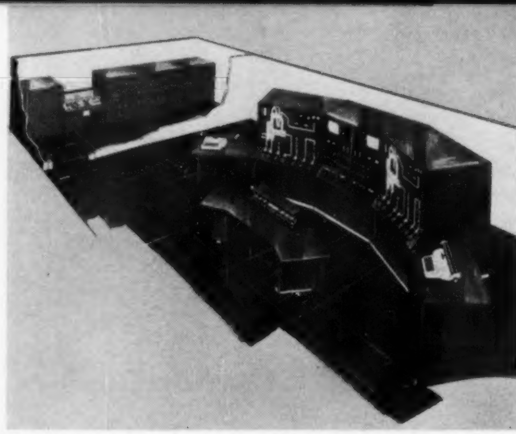
Besides the built-in quality control, roughly 35 to 40 per cent less time per hole is required.

Three machines are used to produce about 350 different standard precision boring bars quickly and economically, as well as those for special purposes, including automated tooling.

Hole dimensions and seats of the bars are so accurate that the tooling for bars in automatic operations can be preset away from the machine in groups ranging up to several hundred, with full assurance that, when placed in bars, the tooling will always hold final size, or require only minimum adjustment. In repetitive machining, down time for tool changing is thus fully minimized.

Because the machine's pivot point is dead center of the center line of the spindle bar as well as the work-holding fixture at all times, it requires only a simple mathematical calculation along the center line of the bar involved to establish the initial pickup for machining and hold the relationship between a series of straight and angular-mounted holes in the bar. Also, all holes regardless of the number involved can be identical in depth, if required.

Because a new hole machine's pivot point is dead center of the center line of the spindle bar as well as the work-holding fixture at all times, a single "fix" from the gage line or face of a boring bar enables it to hold all subsequent dimensions



Two peaking turbines of an existing power station will be automatically controlled with special computer equipment. Modifications to the turbines will include addition of a wide-range governor to control turbine-speed setting.

Computer for Existing Power Plant

AN EXISTING power plant of Gulf States Utilities Company will be the first to be modified for operation with computer equipment by the end of 1961. Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has been awarded the contract.

When completed, the Riverside Power Station, at Lake Charles, La., will have the necessary controls to allow two Allis-Chalmers turbines—a 35,000 and a 40,000-kw unit—to be automatically started when required for peak loads and shutdown as the load decreases. The computer will continuously calculate the heat rates of the station so that the plant can be automatically regulated at all times to maintain desired conditions.

At this time, J. A. Reich, Mem. ASME, production manager of Gulf States, said, "It is merely a matter of back-feeding the circuit and the automatic station is in our immediate reach."

The Allis-Chalmers turbines and associated equipment will be modified to facilitate computer control. A wide-range governor will be added to control the turbine-speed setting from turning-gear speed to operating speed.

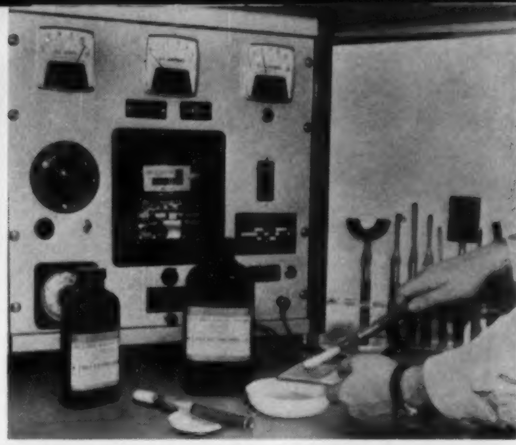
In addition to the turbogenerators, the new plant modifications will include automatic control for start-up, sensing, measuring, and controlling temperatures and flow in boiler, condenser, heaters, pumps, and the electrical-distribution system. Additions will be made in the area of safe operation for combustion and fuel safety in the steam generator. An important adjunct will be the maximum possible reduction in start-up time from cold shutdown to full load.

Thermal expansion and bearing vibrations will be measured by detectors and logged by the computer. These and other signals can be printed on trend recorders for visual observation by the operator. Thermocouple signal from temperature detectors in the journal bearings, thrust bearings, hydrogen seals, and generator will be used in establishing maximum rates of load change.

An important feature of this new control system is the increased safety to the operating personnel and equipment. The system will also increase the flexibility and reliability of the plant. It will be possible to put the turbines on the line considerably faster than previously and to respond quickly to changes in requirements.

The instrumentation and data-processing system necessary for computer operation of the facility will be designed and manufactured by Consolidated Systems Corporation, Monrovia, Calif., an associate company of Allis-Chalmers, Bell and Howell, and Consolidated Electrodynamics.

A curtain of water drenches the new telescoping passenger-loading bridges to provide a safe exit for passengers if fire breaks out on the airport apron during the fueling of jet planes while passengers are aboard the aircraft



Plating thicknesses are precisely controllable and easily limited to those areas where plate metal is actually needed with a new selective plating process. The unit is easily moved for use wherever it is needed in the shop.

Water Curtain Protects Passengers

A CURTAIN of water released by a quick-acting valve will provide a safe exit for American Airlines passengers at New York's International Airport in case a fire breaks out while the plane is refueling. The water will be discharged from spray nozzles above and below the new movable telescoping-passenger-loading bridges.

This deluge system employed on all eight terminal loading bridges is connected to 4-in. fire standpipes served by a 500-gpm Peerless fire pump. The pump is driven by a 50-hp motor and operates against a 231-ft head. Suction is from a city water main at approximately 60-lb pressure. A manually opened 2-in. Everlasting valve made by Everlasting Valve Company, Jersey City, N. J., will release volumes of water instantly to 2-in. lines feeding spray nozzles above and below the loading bridge.

Six upper spray nozzles fan out the water to drench the steel-sheet panels along the entire length of the loading bridge. Spray nozzles spaced at equal distances in the angle formed with the building wall beneath the cantilevered loading bridge will quickly wash away burning fuel on the concrete apron.

After the valve is reset to shut off the deluge system, the water remaining in the system flows through a $^3/_4$-in. drain to grade level. The deluge system was designed for the new American Airlines Terminal building by Jaros, Baum and Bolles, consulting engineers.

Second MHD Generator

A SECOND magnetohydrodynamic experimental electric generator is undergoing initial shakedown runs at the Avco Everett Research Laboratory in Everett, Mass.

This intermediate generator is a step between an eventual full-scale commercial power station and the pioneer laboratory device announced in 1959 by Avco Corporation and a group of 10 utility companies. The possible power output is much greater than that of the original Avco MHD generator which weighed 3 tons and produced 10 kw of power for brief periods.

The first of the preliminary runs was announced in a progress report delivered by Arthur Kantrowitz, director of the Avco Everett Research Laboratory, at the 1960 ASME Winter Annual Meeting (MECHANICAL ENGINEERING, January, 1961, p. 95).

Philip Sporn, Hon. Mem. ASME, and president of American Electric, who represents the 10 utilities participating in the research, said, "The past year's work reinforces our belief in the great potentialities of MHD power generation and its development as a more economical means for mass power generation than any of the existing systems."

The MHD power generator consists basically of a very hot ionized gas channeled through a powerful magnetic field. As the hot gas passes through the magnetic field, it generates electricity. This is similar to a well-known principle of generating electricity by passing a metal armature through a magnetic field. The MHD system is mechanically simpler—there are no moving parts in the generator—and promises efficiency 25 per cent or more over existing power generators.

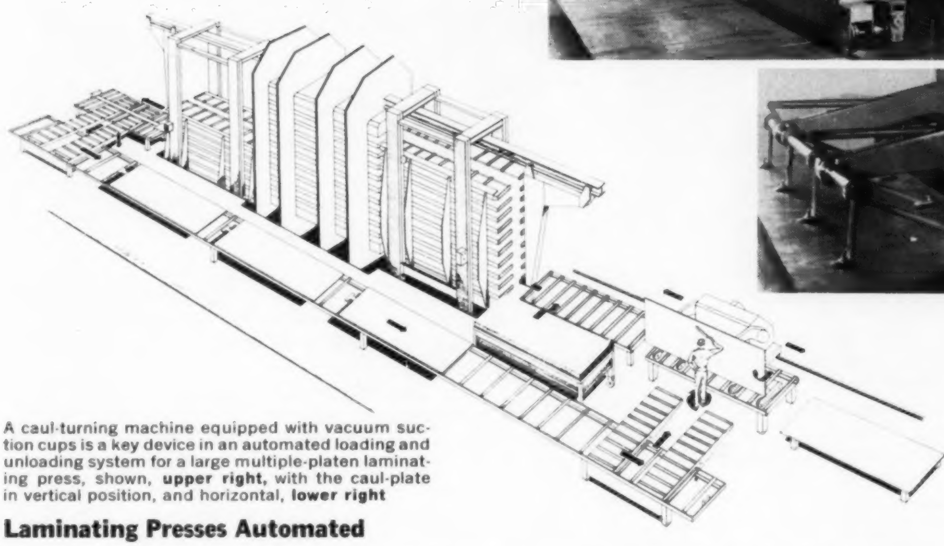
Selective Plating Process

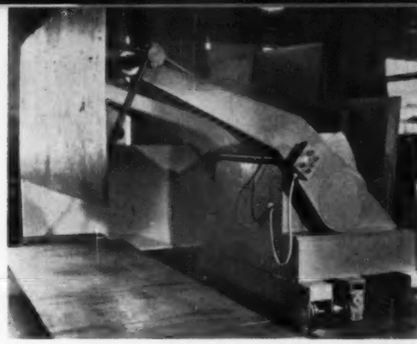
A BRAND new selective plating process is being marketed by Selectrons, Ltd., New York, N. Y. Through the use of a special power pack, plating styluses, and nontoxic, generally basic electrolytes, all made in the United States, the process permits the deposit of many metals and alloys on almost any conductive base material. Thicknesses are precisely controllable and are easily limited to places where plate metal is actually needed.

Several sizes of power supplies are available for use at a-c voltages generally found in industrial plants. D-c output is variable, to suit the engineering needs of the particular application. Selectron styluses are being manufactured for flat, concave, and convex surfaces.

Assembled in light, compact housings, Selectron power packs are easily moved from one shop location to another, wherever their on-the-spot plating capabilities can best be utilized. Readings on totalizing ampere-hour meters are readily converted into exact deposit thicknesses, because each Selectron electrolyte is compounded for a known rate of deposit. These values are shown on the label of each bottle. More than 30 different high-speed plating electrolytes are currently available. They include several alloys, cleaners, and auxiliary solutions.

A major advantage of the Selectron process is the fact that it permits plating of selected areas, without extensive masking or stopping off, and without the need for large tanks filled with expensive electrolyte. The process is particularly suited for prototype work, where new solutions are to be tried; for production work when large components need plating in small areas; and for maintenance and repair, because selective plating often eliminates the need for complete dismantling and reassembly of a piece of equipment.





A caul-turning machine equipped with vacuum suction cups is a key device in an automated loading and unloading system for a large multiple-platen laminating press, shown, **upper right,** with the caul-plate in vertical position, and horizontal, **lower right**

Laminating Presses Automated

An automated loading and unloading system for large multiple-platen laminating presses has been developed by Pathex (Canada) Ltd., Toronto, Ont., an industrial engineering firm.

Believed to be the only system of its kind, six installations are now in operation in Canada and the U. S. Additional orders are currently in process for European concerns. Considerable increases in production efficiency and cost savings are reported. The system also has wide application in the production of plywood and wood-composition laminates and a variety of other types of nonmetallic sheeting.

The demand for plastic laminates has been so great over the past few years that manufacturers have often found difficulty keeping pace. Hydraulic presses of gigantic proportions have evolved with working pressures up to 6000 tons. Multiple-platen presses now simultaneously produce up to 75 sheets of laminate, each 6 by 12 ft.

The basic problem with large presses of this nature has been the excessive idling time required for feeding of materials and removal of finished product. The average press cycle time required by plastic laminates is 80 min. Preparation of materials and caul-plates, feeding and removal of finished product—during which time the press is idle—can be as much as 30 min with manual methods. The Pathex system cuts this idling time down to about 30 sec.

Up to five sheets of laminate impregnated with thermosetting resins may be sandwiched between thin steel caul-plates and carrier plates. These "books" must then be placed between the platens of a press and cured under heat and pressure.

Caul-plates must be cleaned between each cycle to remove oil or abrasive particles which would ruin the surface of the laminate and interfere with the curing process. These plates are usually about 5 by 12 ft and difficult to handle.

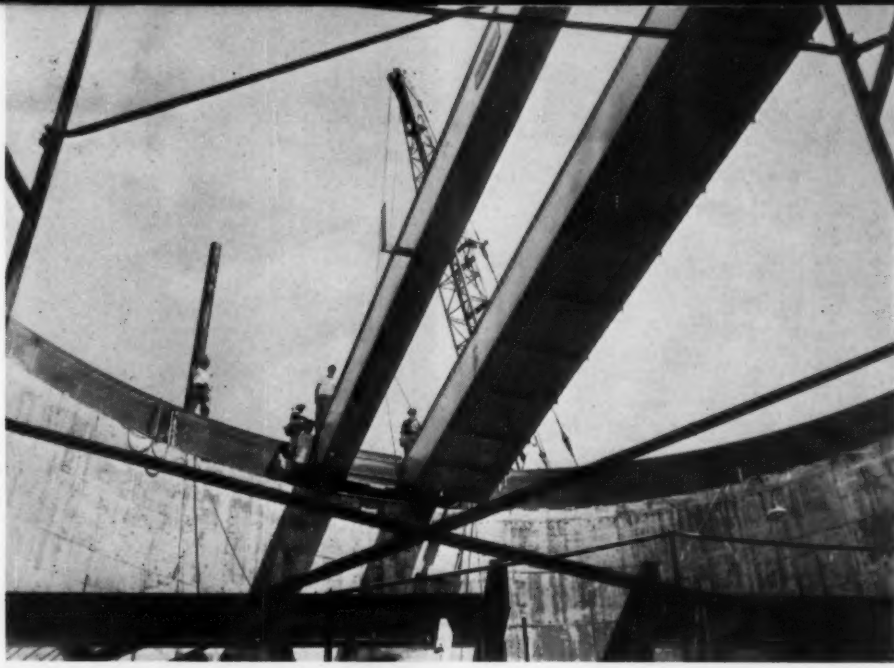
Ideally, a 15-platen press would have just two sets of caul-plates and carrier plates, one set being in use in the press while the other set is transferred, removed from the finished product, cleaned and inspected, reassembled with further laminate materials, and placed in the loading position. For optimum efficiency, this work must be performed during the cycle time of the press—approximately 80 min.

With the Pathex system this optimum is achieved so that the press is actually idle for only 30 sec while the automatic loading-unloading function is performed. Only two sets of caul-plates and only two men are required per press. The actual press operator works from a remote-control room and may control up to five 15-platen press installations of this type.

There are four basic units and a transfer-conveyer line: (*a*) A self-contained push-button-operated hydraulic caul-turning machine; (*b*) a multiple-layer cage arrangement of short lengths of free-roller conveyer which serves as the loading unit and is raised and lowered by a Saginaw screw system to align with the assembly station and the platens of the press; (*c*) a horizontal pusher device which feeds the assembled "books" into the loading cage and subsequently into the press; (*d*) an unloading unit similar to the loading unit except that it has a pulling device to remove cured books; (*e*) a transfer conveyer, an intermittent power line which automatically returns the cured books to the loading end of the system. This is also the place where they are disassembled.

Ashless Detergent Single-Grade Oil

A new heavy-duty ashless detergent single-grade motor oil is being test marketed in the Los Angeles area by Standard Oil Company of California. Known as RPM Special Motor Oil, it is claimed to provide big savings to the motorist by reducing engine deposits and wear, thus maintaining new-car performance for a longer period of time than is possible with the present ash-forming detergent oils.



Keeping rates of travel uniform at opposite ends of a polar crane is necessary to prevent jamming. If one end outpaces the other, the effect is to form a chord shorter than the diameter of the circular track on which it runs. A single center drive could not be used and a unique control system "balances" the two motors.

Polar Crane

SATISFACTORY load tests have been completed on the Polar Crane installed at the Watertown Arsenal Nuclear Reactor Facility in Watertown, Mass., by Robert Abel and Company, Inc., Brookline, Mass. The 10-ton-capacity crane operates around the rim of a huge circular tank on a 77 ft $4^1/_2$-in. span.

The Polar Crane runs on a single runway rail which is completely circular in form. Because of this, the crane end trucks always move in opposite directions. The usual center drive, with squaring shaft and direct-driven or gear-driven truck wheels, is not applicable to this type of installation. Individual drive motors at each truck are equipped with an electric brake and enclosed gearing.

A unique control system balances the two motors needed in each installation and prevents one motor from forging ahead of the other. This could occur in a poorly engineered operation as a result of unbalanced loading at one end of the crane. If this happened, the crane would no longer work on the diameter but on a chord which is shorter than the diameter, causing the end trucks to bind and jam.

The method of balancing the drives, however, has proved so effective that no jam-ups have occurred. In spite of this, the control equipment is still furnished with an added safety factor which would automatically release any such jam-ups.

The crane is floor operated with a 5-step variable-speed magnetic control for each motion. In each case the controls are mounted on the bridge, and through the use of an auxiliary monorail system beneath the girder the push-button cable is festooned across the bridge. Thus the push-button control station can move independently of the hoist. In addition, the push-button station can be lowered or raised, enabling the crane to be operated easily from two or three different levels 10 to 20 ft apart.

To bring power to the cranes, safety conductor runs continuously around the inside wall of the reactors.

In operation, hoisting, bridge, and trolley speeds of both Polar Cranes are identical: main hoist, 12 fpm; auxiliary hoist, 30 fpm; bridge 60 fpm; trolley, 40 fpm. Maximum lift is 71 ft.

The crane was built by the Shepard-Niles Crane and Hoist Corporation and furnished and installed by the Robert Abel organization.

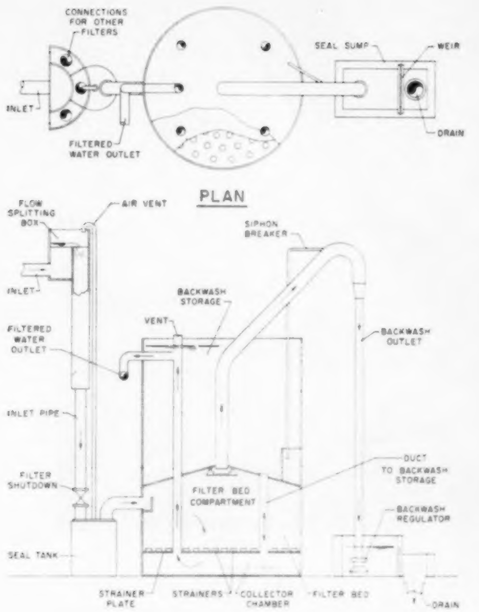
"Wire-Less" Control

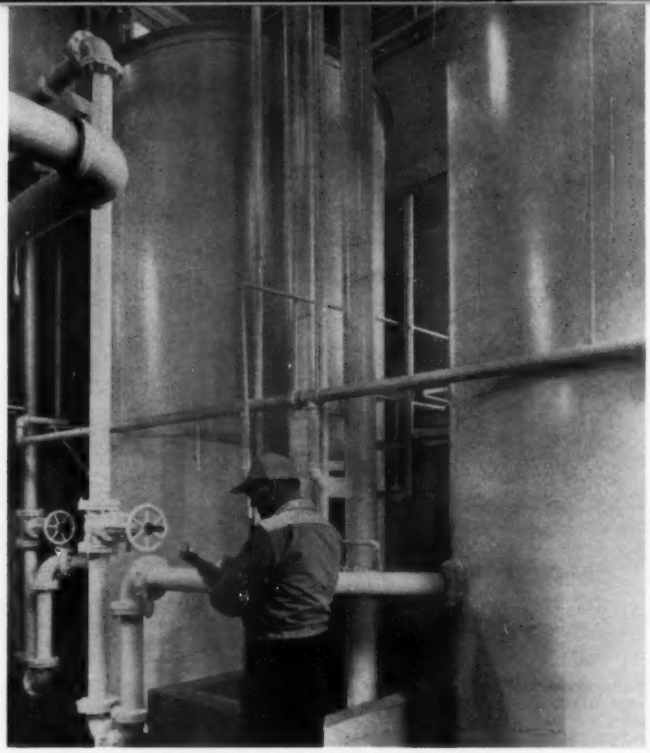
SUPERIMPOSING a 240-cycle signal on an ordinary electric power system will permit street lights to be turned on, alarms to be sounded, or widespread control functions to be performed without a separate system of wires. Utilities will be able to use the device, for example, to control water heaters or other load-building devices for off-peak service.

The principles involved, according to *Electrical Engineering*, December, 1960, were developed by Midwest Research Institute of Kansas City for the Office of Civil and Defense Mobilization as a means of alerting the public in case of emergencies such as enemy attack or local disasters.

A device developed for this purpose is made by AC Spark Plug Division of General Motors. Called NEAR, National Emergency Alarm Repeater, it is approximately $3 \times 3 \times 2$ in. and plugs into any standard 120-volt a-c outlet. When a 240-cycle signal of 10 sec or more is received over the power line, the alarm will sound for about 50 sec and then shut itself off. If the signal is repeated or continued on the power line, the alarm will sound again after a 10-sec delay. The devices could be mass produced for about \$5 to \$10 each and would use about 50¢ worth of electricity a year.

A test demonstration of 1500 NEAR devices has been made in Charlotte, Mich. The receivers were located in homes, offices, factories, and business places within the city of 8000. Residents released weather balloons anchored to float 150 ft over house tops to demonstrate visually that the test was successful.





A fully automatic valveless gravity water filter for municipal and industrial use is built around a very old device—the siphon. This is combined with a filter bed in a compartmented tank. The siphon performs the backwash operation automatically, without pumps, valves, gages, or manual or electric controls anywhere in the unit.

Valveless Water Filter

The Permutit Company has introduced a new fully automatic valveless gravity water filter for municipal and industrial use built around a very old device—the siphon. This is combined with a filter bed in a compartmented tank. The siphon performs the backwash operation automatically, and there are no pumps, valves, gages, or manual or electric controls anywhere in the unit. Actuation of the backwash cycle is accomplished at exactly the optimum moment without any outside aid; the filter cannot over or underwash; and backwash or rinse water cannot be accidentally run to service. The unit operates on a loss-of-head and can be used wherever gravity feed is feasible.

Simple and rugged in construction, the Permutit automatic valveless gravity filter is remarkably "bug-free." It consists of a vertical cylindrical steel tank divided into three sections—backwash storage chamber (at top), filter-bed compartment, and collector chamber under a false bottom. The backwash storage space is designed to hold the optimum amount of backwash water in relation to the surface area of the filter bed below it. It always fills to the same height and consequently gives an absolutely uniform amount of backwash on every cycle.

The filter bed contains standard fine filter sand supported on a collection system of disk-type plastic strainers, developed by Permutit. This system provides uniform collection of filtered water and uniform distribution of backwash water without the use of gravel. The unit can employ other types of filtering material, such as anthracite, or Neutralite, by simply modifying the rate of wash.

Permutit has found that the valveless filter is superior in service to others in which the backwash is initiated by a time-cycle or visual inspection system. The time-cycle method does not take into account possible variations in the quality of raw water, and visual inspection of the bed is not always a sure-fire indicator of the need for backwashing. Loss of head is the true indicator of the need for backwash, and the valveless filter is activated by this condition.

Automated Sand Reclamation

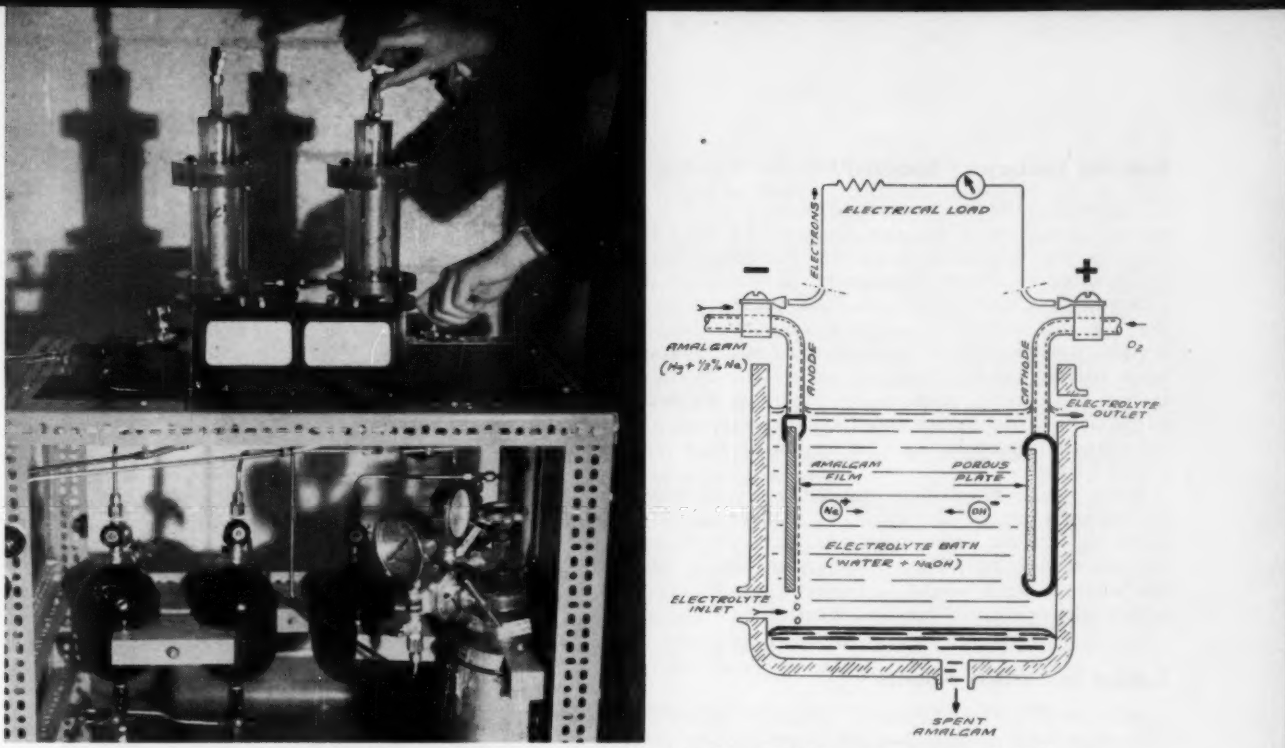
An automated sand-reclamation system has been installed at Empire Steel Castings, Inc., Reading, Pa.

The sand-treating and handling system is designed to minimize the human-error factor involved in securing uniform and consistent sand make-up for cores and molds as well as reduction of handling costs, physical labor, and dust concentration.

The system combines a cooling cascade with special dust control, a high-speed sand-mixing machine, and a dry-type sand reclaimer which greatly reduces the amount of new-sand requirements. A completely automatic control system maintains sand levels at molding stations, and the setting of plows, secures the proper sand formula and mix, and transfers sand to individual hoppers as required. Only one man is required to supervise the controls and prepare the special mixes for the core room. It is estimated that, in addition to providing for superior casting quality and improved sand control, the savings created by the new system will result in a three-year payoff. Sand use, for example, has been cut to less than a third of previous requirements.

Fuel-Cell Power Plant

A new type of fuel cell, whose details were previously classified, has been disclosed by The M. W. Kellogg Company, New York, a subsidiary of Pullman, Inc. It operates on a mercury amalgam of sodium, oxygen, and water and develops twice the voltage of hydrogen cells. Plant volume is sharply decreased, as fewer cells are required for a sizable power plant, and storage require-



A new type of fuel cell, previously classified, operates on a mercury amalgam of sodium, oxygen, and water and develops twice the voltage of hydrogen cells. A prototype Naval power plant will be based on it which will produce fuel-cell power in relatively large quantities.

ments for sodium are considerably less than those for hydrogen.

The prototype will develop about 100 hp or 75 kw. Together with fuel-storage space, it will be about 15 times lighter than the standard electric batteries now in use, and will weigh between 2 and 3 lb per kwhr of capacity.

In this as in other fuel cells, the energ from a chemical reaction is converted directly to electrical energy rather than appearing as heat, with energy-conversion efficiencies as high as 60 per cent. The basic reaction can be expressed

$$4Na + O_2 + 2H_2O \longrightarrow 4NaOH + \text{energy}$$

The direct application of this reaction has been complicated by the great reactivity of sodium. An attempt to use a pure sodium electrode in an aqueous electrolyte would clearly lead to an explosive reaction. A dilute solution, or amalgam, of sodium in mercury is used as the electrode. The direct reaction of sodium with water is suppressed in the amalgam, while the sodium is made available for electrochemical use.

The dilute sodium amalgam (a liquid with physical properties similar to mercury) is supplied to the cell, forming a thin flowing film on the surface of a steel plate. This film forms the anode of the cell. A portion of the sodium is stripped from the film; depleted amalgam falls to the bottom of the cell and is removed.

Oxygen gas is supplied to a hollow cathode, one surface of which is a specially formed porous plate of sintered metal or carbon. The space between the electrodes is filled with electrolyte (an aqueous solution of hydroxide).

Electrical power is drawn from the cell by external connections to the amalgam anode and the oxygen cathode.

At the amalgam anode the reaction is

$$4N_{(Hg)} \longrightarrow 4Na^+ + 4 \text{ electrons}$$

The sodium ions travel into the electrolyte, while the electrons from the anode travel through the external electrical circuit to the cathode where they react as follows:

$$4 \text{ electrons} + O_2 + 2H_2O \longrightarrow 4OH$$

That is, electric current from the external circuit combines with supplied oxygen plus water from the electrolyte to form hydroxyl ions in the electrolyte. There the sodium and hydroxyl ions form an ionic solution of sodium hydroxide:

$$4Na^+ + 4OH \longrightarrow 4NaOH$$

As the process continues, electrical energy is generated through the external circuit, sodium and oxygen are consumed, and caustic is generated in the electrolyte, which becomes increasingly concentrated.

The design of a satisfactory cell is only a small part of the problem of developing a fuel-cell power plant. A complete plant must include not only a system of chemical supply but means of controlling amalgam and electrolyte concentration, together with sensing, circulation, and heat-transfer apparatus, the last to remove heat generated in the cells. To produce a satisfactorily high voltage, a number of cells must be connected in series. The power plant thus represents a chemical process plant in miniature. To be successful in most applications, these circulation and control functions must be simplified, condensed, and engineered into an integrated design, as has been done so successfully in the design of internal-combustion engines. Depleted amalgam must also be processed.

Kellogg has received a $764,000 contract with the Navy's Bureau of Ships to design and test a complete power plant, a prototype of a Naval power plant. This will represent one of the first large applications of the fuel-cell principle to specific power and service requirements.

Keeping Lotteries "Straight"

"A truly random distribution of numbers" is guaranteed by a lottery machine designed by the Central Institute of Industrial Research, Blindern, Norway. As reported in *Product Engineering*, November 7, 1960, "cheating" or uneven performance is prevented by having: (*a*) All numbers engraved in random order on the periphery of the wheels; (*b*) individual wheels mounted on a common shaft driven by an electric motor, but started at different moments by providing for unequal adjustment of the friction couplings; (*c*) stopping wheels individually by operating a brake button that acts on one at a time.

When all the wheels have stopped, a shutter is opened by pulling a handle, and the lucky number can be read. Then the release knob starts the process over again. Operation takes only 2 sec (plus reading time); and the machine can be arranged to project the numbers on a screen or to operate by remote control.

Latest in "White Rooms"

At New Departure's plant in Sandusky, Ohio, a new ultraclean "white room"—a room designed to prevent dirt and dust from getting to high-precision parts—has been designed to provide the finest possible environment for the assembly and testing of superprecision miniature bearings.

The company (a division of General Motors) has been developing the white-room idea (see also Mechanical Engineering, January, 1959, p. 52) since 1935 when it built its first, and probably the industry's first, at Meriden, Conn.

In its evolution, the white room has come from a simple, air-conditioned room, pressurized so that all airflow would be outward, to the present highly sophisticated enclosure which, in some respects, far exceeds surgical cleanliness.

Air is taken from the room and filtered for a $^3/_{10}$-micron maximum dust particle.

The only perpendicular or right-angle intersections of surfaces are at door jambs and headers. Ceilings and floor surfaces are coved into walls and partitions on sweeping radii.

All vertical walls are stainless steel or plate glass. All steel is copper-wire grounded to discourage static. Copper grounding is concealed behind streamlined stainless moldings.

All vertical walls and partitions "lean" into the clean areas at approximately 3 deg off plumb, to deter adhesion of precipitating dust particles and to deflect glare.

Even screwheads, potential resting places for dust, are covered with stainless buttons that streamline them into flat surfaces.

Plastic metal, hard enough to require filing or grinding to get smooth, is flowed into all crevices.

Lighting at work level is maintained in excess of 200 foot-candles, diffused through plastic, prismatic lenses to eliminate glare.

As far as possible, all wiring, light bulbs, and tubing can be serviced and replaced from outside the glass enclosure.

Temperature is held to ± 1 F and relative humidity to between 30 and 40 per cent. A complete air change is made every 3 min.

Lightweight urethane-foam insulation panels with plywood facing are interlocking and require no bolts, braces, or other support

Materials Briefs

▶ Prefabricated Insulating Panels for Trucks

An insulation panel made by Urefoam Corporation, Camden, N. J., from rigid foamed polyurethane has a waterproofed plywood face and an aluminum-foil back. The panel is constructed to be interlocking for airtight construction and has shiplap joints which provide 6 in. of sealing surface between each panel. The urethane foam is Armstrong Cork Company's Expandofoam. The panels are "floated" into place without bolts, braces, or any other heat conductor running from the outer frame through the insulation. Waterproof mastic is used at the joints. Panels can be cut with an ordinary saw.

▶ Aluminum Alloys With 50,000-Psi Ultimate Tensile Strength

Aluminum 21 per cent silicon alloys with ultimate tensile strengths approaching 50,000 psi and potential for automotive-engine-block and cylinder-head castings were described at a recent symposium sponsored by AIME at the 42nd National Metal Congress.

Developed by the Ford Motor Company, the new alloys have unprecedented mechanical properties, particularly for high-silicon alloys, which are higher than those of commercial automotive-casting or heavy-duty piston alloys currently in use. In addition to their high strength, they have excellent hardness, impact, and antifriction properties, low density, and lowered thermal-expansion coefficients.

Alloys of similar composition have been used for pistons in Europe for some time, but their poor foundry characteristics, excessive variation in properties, and poor machineability have caused them to be generally neglected in this country.

To achieve the superior properties demonstrated by the Ford metallurgists, the alloys have been modified to

produce a material with the finest possible microstructure. From the foundryman's point of view, the alloys possess the advantage of little or no loss in refinement during remelting, superheating, or holding at elevated temperatures.

The alloys have been studied in sand-cast, chillcast, and permanent-mold specimens with results which suggest their ultimate use for liner-free engine-block castings.

▶ USS T-1 Type A Steel

Significant savings in the fabrication of stronger, lighter steel structures and equipment are promised by a new, low-cost constructional alloy steel announced by U. S. Steel Corporation.

Designated as USS T-1 Type A steel, the new alloy is available in quenched-and-tempered plates and bars ranging from $^3/_{16}$ to 1-in-thick inclusive.

In this thickness range, it has the same 100,000-psi minimum yield strength, the same degree of toughness, weldability, and resistance to impact and abrasion as USS T-1. But USS T-1 Type A steel costs significantly less because of differences in chemical composition.

The new alloy is expected to bring immediate savings in such uses as bridges, buildings, earth-moving and mining equipment, truck frames and bodies, and oilfield rigs.

Plates of USS T-1 Type A steel are available in all the widths, lengths, and qualities (including flange, firebox, and aircraft) currently furnished in USS T-1 steel.

If extra hardness is needed, USS T-1 Type A can be furnished to a minimum Brinell hardness of 321.

▶ Device Minimizes Corrosion in Condensate Piping

Savings approaching \$5 million a year are reported by Federal defense agencies using a simple device developed by the Bureau of Mines to warn of corrosion in steam-condensate piping at Government heating and power plants.

The corrosion detector is a series of metal rings fitted into a machined pipe nipple, which is inserted in a steam-condensate line so the rings are exposed to water the line carries. Examination of the rings after exposure enables technologists to determine the cause of any corrosion found, and to prescribe improved logists to determine the cause of any corrosion found, and to prescribe improved practices or water-treatment procedures that minimize damage to condensate piping.

▶ Welded Hydraulic-Line Tubing

A line of Lectrosonic cold-drawn welded carbon-steel tubing, claimed to be "equal or superior" to the seamless carbon-steel tubing conventionally used, has been placed on the market by The Babcock & Wilcox Company. It is fully tested and approved for hydraulic-line use by machine-tool producers. The tubing permits savings of up to 35 per cent in materials costs.

The Joint Industry Conference, JIC, adopted new hydraulic standards for industrial equipment in April, 1959, which included specifications for welded carbon-steel tubing for the first time. This makes optional the use of welded hydraulic tubing as an alternate for more expensive seamless tubing.

B & W will triple production of cold-drawn tubing at the company's Keystone plant in Alliance, Ohio. In addition to the manufacture of welded hydraulic-line tubing, the new facilities produce "smooth-ID" cylinder tubing and heat-exchanger tubing.

Babcock & Wilcox electric-resistance-welded hyraulic-line tubing will be marketed under the company's Lectrosonic trade name.

▶ Composite Tubing Provides Corrosion Resistance

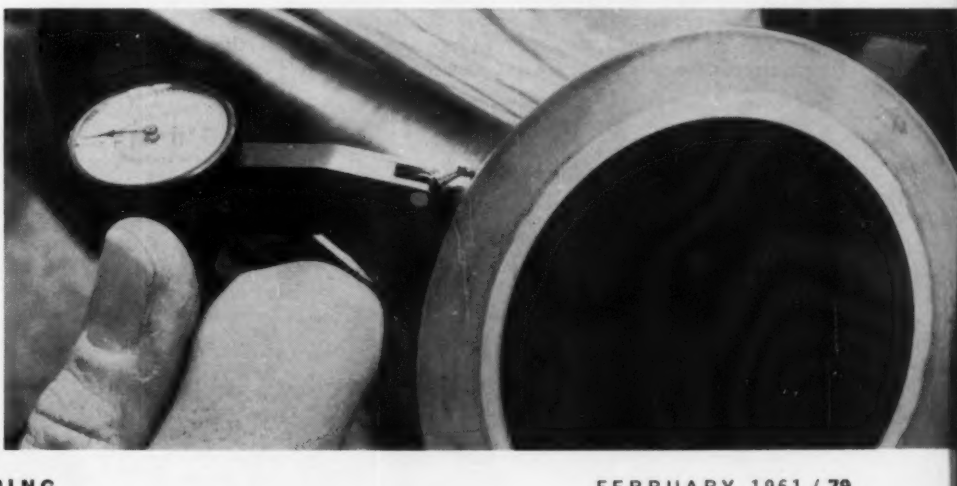
Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., is producing composite tubing for Standard Pressed Steel Company of Jenkintown, Pa., which has an inside lining of corrosion-resistant stainless steel on a carbon-steel outer casing.

It is produced by a method which combines the Ulam process for cladding metals and a hot-extrusion process for transforming billets to tubing. Tests show that a complete and inseparable metallurgical bond of high strength is formed between the two types of steel.

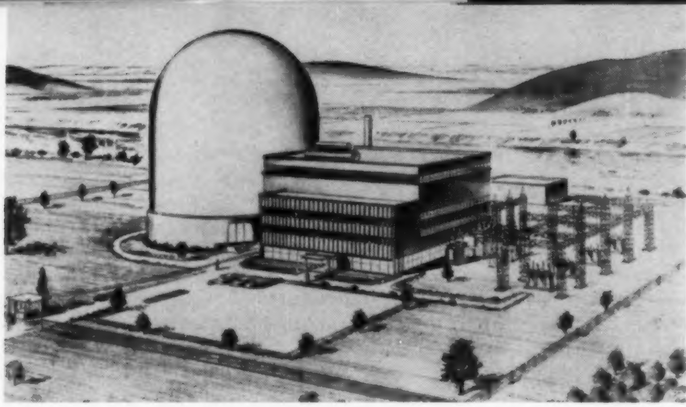
Made for a nuclear-reactor application, the stainless-steel interior of the tubing carries coolant while the carbon-steel exterior is exposed to normal atmospheric conditions and also permits a strong weld of the tubing to the reactor structure.

The corrosion resistance is increased by cathodic-type protection resulting from the metal combination. The metallurgical bond eliminates any possibility of a corrosive medium seeping between the liner and the outside carbon steel.

The increased thermal conductivity and decreased thermal expansion of the composite tubing give added assurance of corrosion resistance.



A complete and inseparable metallurgical bond of high strength is formed between two types of steel to form a corrosion-resistant composite tubing with increased thermal conductivity and decreased thermal expansion. It is produced by a combination of the Ulam Process for cladding metals and a hot-extrusion process for transforming billets to tubing.



A high-temperature gas-cooled nuclear power plant in the 300,000 to 500,000-kw size range is one goal of an intensive development, design, and construction program jointly sponsored by seven N. Y. State utilities. Competitive cost with fossil fuel plants will be another goal.

Nuclear Program for N. Y. State

An intensive program looking toward the development, design, and construction of a large economically competitive 300,000 to 500,000-kw nuclear power station has been announced by seven investor-owned electric companies serving New York State.

A nonprofit corporation has been formed, to be known as Empire State Atomic Development Associates, Inc., ESADA, which will investigate advanced concepts of two types of nuclear power plants that show marked promise of achieving lower cost than coal, oil, or gas. ESADA has contracted separately with the General Electric Company and General Atomic Division of General Dynamics Corporation to conduct an initial development program totaling more than $20 million. The utilities, through ESADA, will contribute more than $10 million of this.

General Electric will design and construct a reactor of about 15,000 tkw (5000 ekw) at its Vallecitos Atomic Laboratory. This test facility will be operated to demonstrate technical feasibility and the improved economics of nuclear superheat for ultimate application to large-scale power plants. General Electric is now doing extensive work on nuclear superheat in co-operation with the Atomic Energy Commission.

General Atomic will proceed with development work aimed at a complete high-temperature, gas-cooled-reactor power plant of 300,000 to 500,000 ekw which will produce steam suitable for use in modern high-efficiency turbines. General Atomic is particularly fitted for this work because it has conceived and is developing the 40,000-kw prototype high-temperature, gas-cooled reactor to be completed at Peach Bottom, Pa., in 1963.

The ESADA program was initiated by a state-wide utility company planning and study group, which was organized 15 months ago by the same seven utilities. Called Empire State Utilities Power Resources Associates, ESUPRA, it will plan ways of meeting the state's future electrical needs at the lowest possible cost.

Niagara Mohawk, Long Island Lighting, New York State Electric and Gas, Consolidated Edison, Rochester Gas and Electric, Orange and Rockland Utilities, and Central Hudson Gas and Electric are the participating utilities.

The ESADA project is in addition to an already substantial investment by New York State utility companies in other atomic projects which employ various reactor types. Consolidated Edison is completing a $100-million pressurized-water plant at Indian Point, N. Y.

Niagara Mohawk, New York State Electric and Gas, and Rochester Gas and Electric are among the 53 member companies of High Temperature Reactor Development Associates, Inc., which is building the Peach Bottom prototype plant.

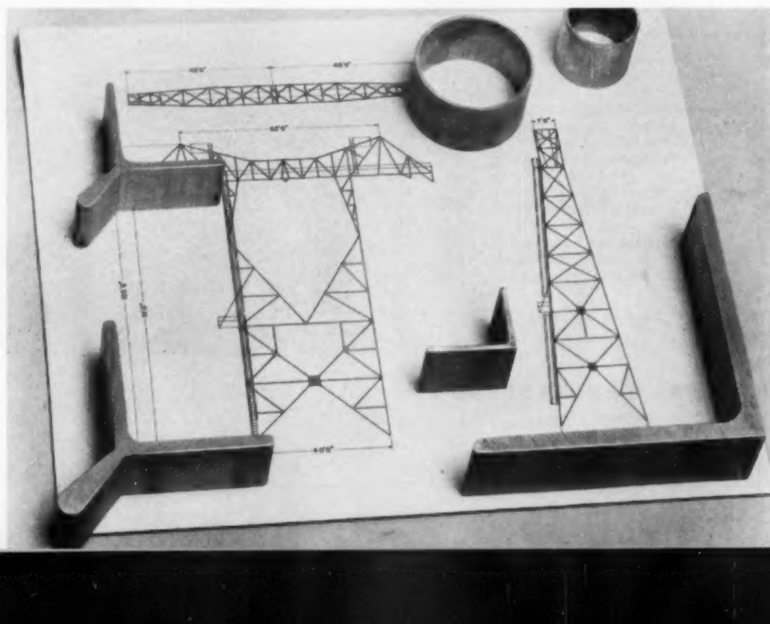
All of the ESUPRA companies, except Orange and Rockland, are members of one of the two companies engaged in the engineering design or construction of the Enrico Fermi Fast Breeder reactor.

Aluminum Tower for EHV

A huge all-aluminum electrical power-transmission tower has been designed and built by Aluminum Company of America for General Electric Company's Project EHV, Extra High Voltage, prototype 750-kv transmission system, being built near Pittsfield, Mass.

The 105-ft-high, bolted structure, which represents an optimum design for aluminum, utilizes three types of extruded-aluminum structural shapes, each in a range of sizes. In addition to tubular sections used for compressor members of the web system, and angles used for tension members, there is a unique, specially designed Y-shape for legs and crossarms.

The tower weighs about 15,000 lb in contrast to 40,000 lb for a comparable high-strength steel tower. All of the tower's structural members were extruded from 6061-T6 aluminum alloy and the bolts are $^7/_8$-in. 2024.



A Y-shaped structural section has been designed specially for use in an aluminum transmission tower. The all-bolted construction is the most economical confirugation that could be engineered in aluminum for extra-high-voltage power transmission. The 105-ft-high towers are part of the General Electric Company's Project EHV.

Nuclear Briefs

▶ GCRE Operates at Design Power With New Core

The Atomic Energy Commission's Gas-Cooled Reactor Experiment at the National Reactor Testing Station in Idaho was operated with a second core at design power of 2000 tkw. The new smaller and lighter core is a step toward the development of the ML-1 prototype mobile, gas-cooled nuclear power plant for the Department of Defense. Containing pin-type fuel elements, it is the first model of the type which will permit the ML-1 to produce 300 to 500 kw of electricity for a full year.

▶ "Coated-Particle" Nuclear Fuel

Battelle Memorial Institute, Columbus, Ohio, has been assigned the task of conducting a three-year research program on the "coated-particle nuclear fuel concept," under an existing AEC contract. The objective of this extensive program is to develop coated particles with high-temperature properties, fission-product retention capability, and good neutron economy. This program will provide much of the fundamental information required in support of the over-all Commission effort on coated particles.

In the coated-particle process, small grains of the fissionable nuclear fuel compound—comparable in size to common table salt—are coated individually with a dense, refractory material that will both protect the fuel from damage by chemical reaction at the high temperatures of the nuclear reactor and prevent escape of the troublesome radioactive by-products formed in the fuel by the fission process. Both carbon and alumina coatings have worked well in early tests conducted at Battelle in work related to the pebble-bed-reactor concept. After coating, the fuel particles are evenly dispersed, like gravel in concrete, in a material, such as graphite, which can be conveniently shaped into reactor fuel elements by mass-production methods. Such a fuel appears particularly attractive for high-temperature operation because only nonmetallic refractory materials are utilized. In contrast, presently used fuel elements are temperature limited by metallic cladding. In addition, good neutron economy can be expected from coated-particle fuels.

Because there is considerable industrial interest in the coated-particle nuclear fuel concept, the program also provides for the evaluation and testing of commercially produced coated particles. Interested manufacturers should contact Dr. R. W. Dayton, Assoc. Mem. ASME, at Battelle Memorial Institute, for information about this evaluation program.

▶ First "Enterprise" Reactor Achieves Criticality

The first of the eight nuclear reactors aboard the *USS Enterprise*, under construction at Newport News, Va., achieved criticality December 2, on the 18th anniversary of the first nuclear chain reaction under the direction of the late Enrico Fermi.

▶ Fuel Shipment Begins for "NS Savannah"

The initial shipment has been made of \$9-million worth of nuclear fuel elements for the *NS Savannah* whose nuclear-propulsion system was designed and manufactured by The Babcock & Wilcox Company.

In all, there will be 36 fuel elements. Four will be "spares," while 32 will be assembled in the reactor core. Each element weighs 760 lb, is 92 in. long and 8.5 in sq, and contains 164 $^1/_2$-in-diam stainless-steel tubes filled with nuclear fuel in pellet form.

There will be 682,200 uranium-oxide pellets bearing 15,620 lb of U235 and U238. When 1.2 per cent of U235, the fissionable isotope, has been consumed, replacement of the core will be necessary. In effect, the *Savannah* will travel on approximately two fuel pellets per mile with a 350,000-mile cruising radius between fuelings. This will immeasurably increase the flexibility of the ship's sailing schedules.

▶ U. K. Nuclear Stations Competitive When Completed?

The nuclear power stations now being ordered in England should generate electricity in about five years at costs not more than 10 per cent above those for new conventionally fueled power stations at today's prices for coal and oil.

J. V. Dunworth, representing the United Kingdom in the round table on the development of nuclear power at the General Conference of the International Atomic Energy Agency in Vienna, Austria, in September, 1960, stated that, "It needs only a 15 per cent rise in oil or coal prices in real terms to offset this difference. This increase could well occur while the nuclear power stations now being ordered are actually being built."

▶ 15-Emw BWR at Kahl, West Germany

West Germany's first nuclear power plant, at Kahl near Frankfurt, the 15-emw indirect-cycle boiling-water reactor supplied by the General Electric Company, went critical in November, 1960. It is the first U. S. reactor supplied to a foreign utility to achieve criticality, according to the December, 1960, *Forum Memo* of the Atomic Industrial Forum, Inc. It will be operated by an organization owned jointly by two German utilities and formed for this purpose.

▶ 35 Million C Achieved in Fusion Experiments

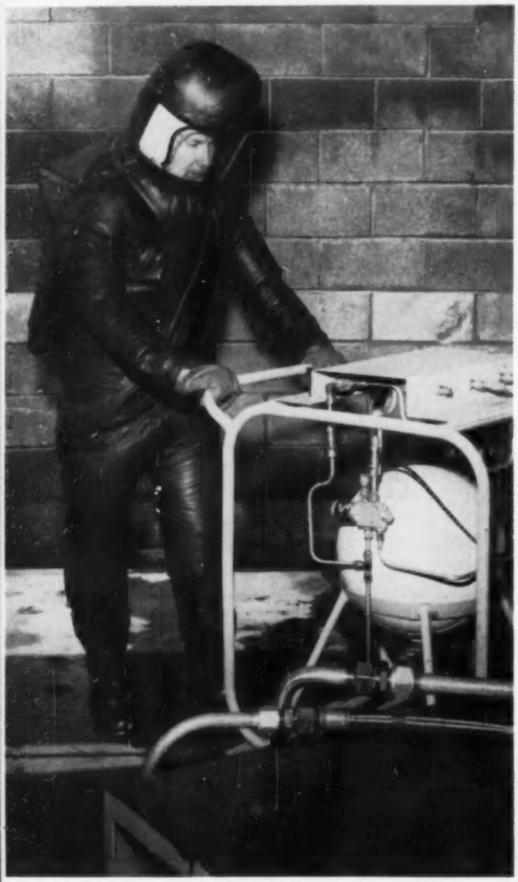
A deuterium plasma has been confined for $^1/_{1000}$ sec at 35 million C in fusion research at the Lawrence Radiation Laboratory, Livermore, Calif. According to the December, 1960, *Forum Memo* of the Atomic Industrial Forum, Inc., the feat was achieved in a new multistage magnetic-compression mirror machine, producing neutrons of thermonuclear origin. A third compression stage will be added to the present two-stage device, in hope of reaching higher temperatures and longer confinement times.

▶ 580-Emw Sizewell Plant, Britain's Largest

The Central Electricity Generating Board has awarded the contract for a \$154-million two-reactor, 580-emw nuclear plant to the consortium made up of English Electric, Babcock & Wilcox, and Taylor Woodrow. The gas-cooled plant will use magnox-clad fuel elements and natural uranium.

According to the December, 1960, *Forum Memo* of the Atomic Industrial Forum, Inc., Sizewell, on the North Sea Coast in Suffolk, is the seventh nuclear plant in the current British civilian electric-power program. It will bring the total nuclear contribution to the British grid to over 3000 mw, about $^1/_{10}$ of the U. K. total electric generating capacity of 30,000 emw. Britain's two plutonium-and-electricity plants—Calder Hall and Chapel Cross—contribute an additional 300-mw.

An economy over previous construction costs will be achieved by having both of the reactors in one building with common fuel-transfer and reactor-servicing machines.



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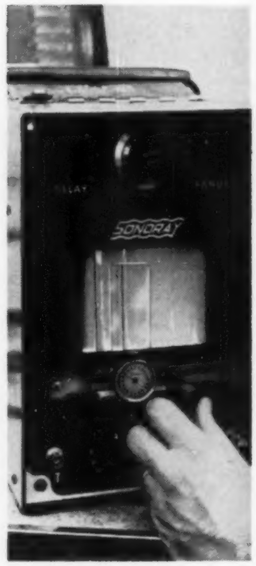

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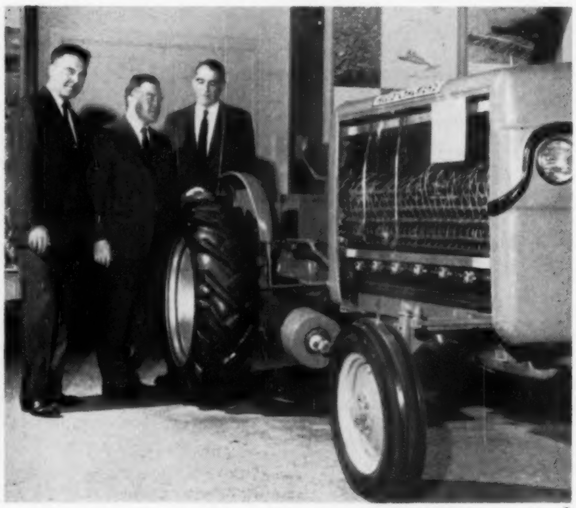

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1 Life-Support System. This rubberized, air-conditioned suit protects its wearer against hostile environments including, with modifications, the rigors of outer space. The Garrett Corporation's AiResearch Manufacturing Division of Los Angeles designed the light, efficient, self-contained environmental-control system for loading missile fuels (toxic fumes). Good, also, for fire fighting and rescue, and for mining.

2 Well Screen. Stainless-steel plate, with punched slots resembling louvers, has been rolled into cylinders to provide screening for the largest well in New England, providing 5,000,000 gal of water per day. The steel: Allegheny Ludlum's type 304 stainless steel, $^{3}/_{16}$-in. plate, punched by National Perforating Corporation, Clinton, Mass. Six 5-ft sections, bolted together, were lowered to the bottom of the 72-ft well.

3 Plastic Exhaust System. This 125-ft exhaust system for use in the steel industry is possibly the world's largest single plastics installation. Corrosion Treatment Corporation of Byesville, Ohio, built two of these systems for a major steel company to remove corrosive fumes from its zinc and tin-plating lines. Seiberling Rubber Company Plastics Division supplied $^{1}/_{4}$-in. corrosion-resistant plastic sheet.

4 Historic Tractor. This is Allis-Chalmers' research tractor that was pictured on **Mechanical Engineering's** cover for December, 1959, the first vehicle powered by self-contained fuel cells—now presented to the Smithsonian Institution. **Left to right:** Will Mitchell, Jr., of Allis-Chalmers Research; E. C. Kendall, an Associate Curator of the Museum; and F. A. Taylor, Director of the Smithsonian Museum of History and Technology.

5 Ultrasonic Micrometer. A caliper attachment equips this "Sonoray" ultrasonic flaw detector (made by Branson Instruments, Inc., of Stamford, Conn.) to measure thickness of metals and plastics, from one side, to accuracies within ±0.010 in. The new accessory determines thickness without calculations or interpolation, and also permits accurate location of discontinuities, voids, slag inclusions, and severe porosity.

6 Microphotography in 3-D. Do you make parts in which the surface is critical? From Graflex, Inc., of Rochester, N. Y., comes this 35-mm stereo camera adapted to a stereoscopic microscope made by American Optical Company. The girl is focusing the microscope on the part (first one lens, then the other); then she will swing the camera into position—and click! A permanent 3-D record of the quality of the surface.

5

6

PHOTO BRIEFS

M. BARRANGON

Plasma Guns. The arc-plasma technique produces extreme high temperatures. These guns, by Plasmadyne Corporation of Santa Ana, Calif., are used in welding or cutting high-melting-point materials, coating surfaces, studying ablation. The new, small one **on the right** is for use in coating surfaces previously inaccessible.

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

More Nuclear Power for Britain

The sixth in the series of nuclear power stations authorized for the Central Electricity Generating Board, which is responsible for Britain's public electricity supply, is to be built at Sizewell, Essex, on the east coast. It will have a capacity of about 580 mw (780,000 hp). Its two reactors are scheduled to come into operation in 1965 and 1966; they will be of the CO_2-cooled graphite-moderated type, using natural uranium as fuel as are the other stations built for the Board. The plant will be notably compact, as the two reactors will be housed in the same building; in fact, it will produce nearly four times as much electrical power as the two pioneer Calder Hall stations together, while occupying only about one third of their area. The value of the contract will be about $154 million. It is to be carried out by the consortium known as the English Electric—Babcock & Wilcox—Taylor Woodrow Atomic Power Group.

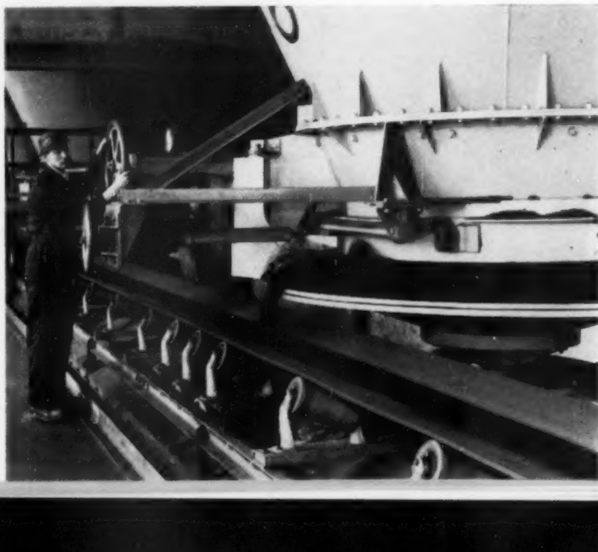
Sinter Plant for Norwegian Iron Ore

The Workington Iron and Steel Company's blast furnaces at Workington, Cumberland, England, have been operating on sintered-ore concentrates for some 17 years to the extent of 6000 tons of sinter per week. This quantity not being sufficient for future needs, a new sinter plant costing $7 million has been constructed and (being designed to use Norwegian ore) has recently been formally inaugurated by Crown Prince Harald of Norway. The ore, which has been found particularly suitable for the acid Bessemer process employed at Workington, is mined in open-cast workings by the Sydvaranger Company at Kirkenes, in the north of Norway, and is shipped direct to Workington in the form of a powdered concentrate containing about 65 per cent of iron. It will represent about the same percentage of the total ore consumption. The balance comes partly from other overseas sources and from the company's own hematite mines in Cumberland.

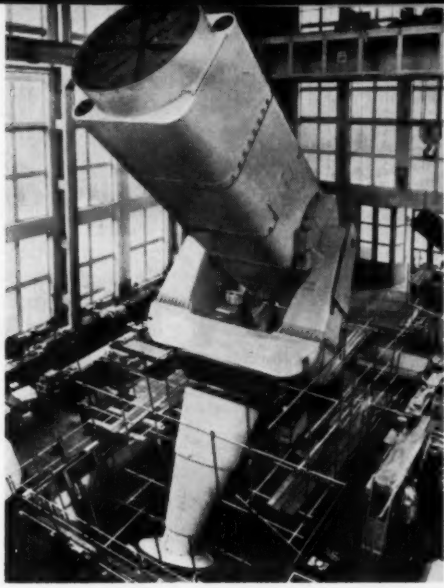
The imported ore is taken by rail wagons to a store holding 44,000 tons, of which 16,500 tons will be the Sydvaranger fines. The sinter materials are fed onto a belt by rotary feeder tables of 9 ft diam; thence to a twin paddle rotary mixer of 200 tons per hour capacity; and so by conveyer to a surge hopper. From there the mixture passes under control to a pelletizing drum, where the final mix is made and the water content adjusted as necessary. By feeding the mix in pellet form, the permeability of the sinter bed is increased and a faster rate of sintering becomes possible. The Head Wrightson/McKee single-strand continuous sintering machine, to which the pellets are transferred by a vibrating feeder, is 6 ft wide and 180 ft long, with an effective grate area of 1008 sq ft. The strand speed is variable between 45 and 170 fpm. The mix is ignited by an automatically regulated mixture of blast-furnace gas and coke-oven gas with combustion air under an ignition hood 6 ft 2 in. long and 7 ft 8 in. wide. Normal operation is with a ratio of seven parts of blast-furnace gas to one of coke-oven gas, but the design permits running on other ratios or with up to 100 per cent of either gas if required. There are 28 wind boxes, and the air blower delivers 2500 cub ft/min at 12 in. wg. Gas from the wind boxes is collected in a straight dust-collector wind main of increasing cross section.

The sinter is discharged to a breaker with knives spaced at 6 in., and thence to a Schenck vibrating screen. A variable-speed feeder passes oversized lumps to a Lurgi-Frodingham circular cooler with a capacity of 100 tons per hr, which cools them from 850 to 100 C. They then go into a hopper and are conveyed to a second screen to be separated into two size ranges before being taken by a transfer car to the furnace bunkers. Undersized sinter also is sorted into two 50-ton bunkers according to size above or below $^3/_8$ in. If larger than that size, it is fed back to the sintering strand as bedding material; if smaller, to the return fines storage bins. Four Buell extraction systems collect the dust from various points in the plant and return it to the primary mixing mill. At full output, the plant will produce 12,500 tons of self-fluxing sinter per week.

Operator adjusts ore feed at "Focus" Sinter Plant in Cumberland, England. Raw feed gathering belt and storage bins are shown.



Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.



Reflecting telescope for Tautenberg Observatory, East Germany, **left,** and its giant reflector, **below,** one of the world's largest.

Giant Reflector for East Germany

ALTHOUGH, so far as the Western world is concerned, the head office of the famous German optical firm of Carl Zeiss is now at Oberkochen, in Württemburg, the original factory at Jena still maintains its traditions of fine craftsmanship, under the modified title of VEB Carl Zeiss JENA. It has recently completed for the new Tautenberg Observatory, near Jena, which is under the direction of the Academy of Sciences, Berlin, a reflecting telescope of exceptional size and novel design, said to be the first of its kind. With its 2-m (6-ft $6^3/_4$-in.) reflector, it is one of the largest in the world and at present is the largest in Europe, though one of 2.6 m is under construction in the USSR.

For examining wide arcs of the firmament, a photographic system on the Schmidt principle is employed, with a focal length of 4 m and an aperture ratio of 1:3, and taking plates 24 cm (9.45 in.) square. The 2-m spherical main mirror is then used in conjunction with a correction plate 1.34 m diam. For the individual examination of celestial objects the quasi-Cassegrain system is used. With the main mirror in conjunction with a hyperdeformed convex countermirror 400 mm diam, this gives a focal length of 20 m (65.6 ft). This system will be used for photoelectric photometry and spectrography. For work requiring instruments of the highest sensitivity (for example, high-dispersion spectrographs) a quasi-Coudé system will be employed, giving a focal length of 92 m.

The tube of the telescope is 10 m long and of square section and is carried in a fork-type mounting of the equatorial type. As the moving parts weigh some 65,000 kg (about 64 long tons) and the whole must follow the stars with the precision of an astronomical clock, the rotating structure is mounted on hydraulic thrust bearings and moves on a film of oil 0.05 mm thick. It is revolved through the medium of a precision wormwheel 2.16 m (7 ft 1 in.) diam, the teeth of which are accurate within less than half a second of arc. The tube, which weighs 26,000 kg (about $26^1/_2$ tons), is actuated electrically in the declination plane. Its motion is transmitted to a central switchboard and several branch switchboards, whence it can be adjusted to the co-ordinates of the object under observation. There is automatic compensation for varying temperature conditions. The main mirror, weighing 2370 kg (about $2^1/_4$ tons), the correction plate, which is 38 mm thick, and the various auxiliary mirrors were cast by the VEB Jenaer Glaswerk. The Cassegrain and Coudé countermirrors differ from the form of a true sphere by no more than 0.05 mm. The spectrographs will produce stellar spectra of a maximum length of 1500 mm (4 ft 11 in.). The complete equipment will be housed in a dome 20 m (65 ft 6 in.) diam and weighing 175 tons, specially insulated to maintain the night temperature throughout the daylight hours, irrespective of sunshine.

Cleaning Oil Tankers

WITHIN quite recent years the River Mersey has become one of Britain's most important oil ports, and within the past year its resources have been increased by the provision of two new discharging berths, each capable of taking a tanker of 65,000 tons deadweight. Hitherto, however, there have been no facilities available to them for cleaning their tanks after discharging. To meet the requirements of the International Convention on Pollution of the Sea by Oil, of 1954, and the Oil in Navigable Waters Act passed by the British Parliament in the following year, they have had to go far out into the Atlantic to the west of Ireland to clean. To meet the need for tank-cleaning facilities a new company, Mersey Tanker Services Ltd., formed jointly by Cammell Laird & Co. (Shipbuilders & Engineers) Ltd., of Birkenhead, and the neighboring ship-repairing firm of Grayson, Rollo & Clover Docks Ltd., have provided a depot where a ship can lie at a jetty to wash out her tanks and can then discharge the oily water to shore storage tanks for separation. The jetty, 550 ft long, can accommodate a vessel of 75,000 tons deadweight at light draught and is accessible at any state of the tide. It is connected to the shore by a 1400-ft pier, which supports a 12-in. ballast-water pipeline, a 7-in. tank washing line, a $2^1/_2$-in. compressed air line, a 2-in. fresh water supply line, and an 8-in. salt-water supply line. At the shore end are two oil separators with a combined capacity of 900 tons per hr, two separated-oil tanks holding 240 tons each, a 700-ton "dry" oil tank, and two tanks for oily ballast water, each to hold 1500 tons. Also provided are a salt-water detergent tank, a fresh-water tank for ships' supplies, and an oil-extraction unit for the removal of oil from sludge. On the jetty are stores, rescue and fire-fighting equipment, and electric switchrooms to control the electricity supply from a substation adjoining the boiler-house and pump house at the shore end.

Substance in Brief of Papers Presented at ASME Meetings

ASME TECHNICAL DIGEST

Boiler Feedwater Studies

Evaluation of Steam Washers in Power-Plant Boilers..60—WA-213... By H. A. Klein, Combustion Engineering, Inc., Kreisinger Development Laboratory, Chattanooga, Tenn. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

A research program was undertaken to study the feasibility of employing steam washers to control silica deposition in high-pressure turbines. Under certain laboratory conditions, steam washing was found to be effective; however, its useful application appears to be limited to a very small number of power stations. Space limitations in modern boiler drums make it difficult to install the bulky equipment without interfering with flow and distribution through the drum. A washer installation can actually be the cause of mechanical carry-over. The use of high-quality make-up water and the prevention of raw-water contamination provide a more economical and trouble-free solution to the silica problem. A steam washer has little practical value in plants where good external control of silica is practiced.

Acid Cleaning of Superheaters and Reheaters..60—WA-219... By William F. Ashton and Stanley M. Rose, Sumco Engineering, Inc., Caldwell, N. J. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

From the time that solvent cleaning proved to be an effective and economical method of removing deposits from internal boiler heating surfaces, there has remained the problem of cleaning any unit that contained various parallel circuits that are either nondrainable or nonventable. The problem of cleaning superheater and reheater elements has concerned the entire power industry as well as the chemical cleaning contractor.

As steam-generator design advanced, superheaters and reheaters were fabricated in an all-welded construction, thus eliminating any possibility of individual flushing of elements.

The object of this paper is to present both laboratory and field experience in the chemical cleaning of drainable and nondrainable superheaters and reheaters.

It is limited to the general discussion of flow characteristics, types of solvents, equipment used, and methods employed, with emphasis on actual results obtained in the field.

Vacuum Deaerator Design..60—WA-214... By A. W. Kingsbury and E. L. Phillips, The Permutit Company, a Division of Pfaudler Permutit, Inc., New York, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

The cold-water vacuum deaerator is finding application in the treatment of industrial waters containing contaminant gases which may interfere with a chemical process or be responsible for corrosion.

A study was made of vacuum desorption of oxygen and carbon dioxide from water using 1-in. Raschig rings in a 2-ft-diam tower having a maximum packing height of 22 ft. The effect of various operating variables on the HTU (height of transfer unit) was investigated and data correlated to give a practical basis for designing vacuum deaerators.

Performance of Stainless-Steel Condenser Tubes..60—WA-217... By Robert H. Pell, Monongahela Power Company, Fairmont, West Virginia. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

In July, 1958, the No. 6 Unit surface condenser of the Monongahela Power Company, Rivesville Power Station, was completely retubed with Type 304 stainless-steel tubing, replacing 88-10-2 copper alloy. This condenser now contains 9234 welded stainless-steel tubes $^{7}/_{8}$-in. OD × 26 ft. × 0.028-in. wall. The replaced superloy was 16 Bwg with a wall thickness of 0.065 in.

The author reports on the evaluation and decision to replace copper-alloy condenser tubes with Type 304 stainless steel, and the performance during the two years since installation.

Precautions in the Use of Citric Acid for Chemical Cleaning..60—WA-221... By E. B. Morris, American Electric Power Service Corporation, New York, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

Following extensive laboratory investigation and pilot-scale testing in 1956, inhibited citric acid was employed for preoperational mill-scale removal from the Philo Unit 6 supercritical-pressure steam generator. Citric acid has since been used three times for operational deposit removal from the Philo Unit. It was also utilized three consecutive times for the Indiana & Michigan Electric Company's Breed Plant supercritical-pressure steam generator. This 450-mw unit was placed in commercial operation in 1960.

Since the first use of this acid on a large commercial scale in 1956, the interest in citric acid has greatly increased, particularly where certain specific requirements must be met. Its characteristics were especially desirable where austenitic alloys were involved in order to avoid chloride stress-corrosion cracking. It met the conditions found in once-through boilers, nondrainable components such as reheaters and superheaters, nuclear power systems, and piping systems.

However, further experience with citric acid has demonstrated that two adverse conditions can occur. These are:

1 Precipitation of an iron citrate from the solvent.

2 Formation of a colored colloidal iron complex if rinsing and flushing are deferred.

This paper explores these two problems and means for their prevention.

German Development in Acid Cleaning of High-Pressure Boilers..60—WA-227... By H. G. Heitmann, Siemens Schuckertwerke, AG, Erlangen, Germany. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Power;** available to Oct. 1, 1961).

A new chemical cleaning method for power plants, especially for plants with forced-circulation boilers, is described. In this method chemical cleaning of the loop is accomplished by utilizing temperatures of over 100 C and pH-values down to about 4.0.

The acid dosing—HCl or sulfuric acid —takes place in the feedwater discharge piping after the boiler feed pump. Before the latter, hydrazine is added to raise the pH-value to over five in order to protect the pump. This serves simultaneously as a "treatment medium" for the acid through the loop. In addition, hydrofluoric acid can be added to the cleaning solution for the removal of silicon, and citric acid for complexing with the dissolved iron. The latter measure will prevent the reprecipitation of dissolved iron. At the time of writing, 14 Benson boilers, two Sulzer monotube boilers, and one drum boiler with the associated power-station equipment have been chemically cleaned by the method developed. These cleanings actually carried out will be described in part and the information derived from them will be explained in more detail.

Chemical Cleaning With Citric-Acid Solutions..60—WA-257... By William E. Bell, Charles Pfizer and Company, Inc., Brooklyn, N. Y. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Within the past 2 years, many cleaning operations with citric-acid-based solutions have taken place. Most of these were preoperational cleaning using inhibited citric. Ammoniated citric-acid solutions were seldom used.

The reactions between citrate ion and steel, ferrous ion or ferric ion have not been completely described in the technical literature, and when these reactions each take place at the same time, as during chemical cleaning, control procedures and interpretation of results can be most difficult. It is a fact that the utility of citric acid in chemical cleaning is more advanced than the science.

The differences in the reaction of citric acid or ammoniated citric acid with steel and iron oxides are discussed.

Chemical Cleaning of Controlled-Circulation Boilers..60—WA-258... By H. J. Vyhnalek, The Cleveland Electric Illuminating Company, Cleveland, Ohio. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Design of steam-generating equipment has taken very diverse courses in the past decade. Cyclone furnaces, monotube units, and controlled-circulation boilers are now quite common in the industry. With the introduction of these specific designs, manual cleaning is impossible. Even standard chemical cleaning procedures must be modified to fit the specific application.

While this discussion deals primarily with controlled-circulation boilers (those which use mechanical pumping within the boiler circuit for water distribution), characteristics may be recognized that can be applied to other high-pressure designs.

Orifices, circulating pumps, and small-diameter tubes, common to controlled-circulation units, are recognized as important factors in setting cleaning specifications. Procedure modifications and additional precautions which help insure a satisfactory job with a minimum of corrosion are described.

New Chemical Cleaning Concepts and Possible Applications for the Future.. 60—WA-259... By Charles M. Loucks, Materials and Methods, Inc., Westlake, Ohio. 1960 ASME Winter Annual Meeting paper (multilithographed; available to October 1, 1961).

The future of chemical cleaning is explored to stimulate discussion on how more technical progress may be motivated and what might be accomplished. Among the new developments suggested are the following:

1 Boilers will be cleaned with materials that will allow the boiler to be fired. Much of the cooling down and warming up and filling and emptying and blanketing with inert gas and post boiling can be eliminated.

2 Superheaters, reheaters, steam lines, and many piping systems and vessels will be cleaned with noncondensed or vapor phases which offer some very interesting engineering properties.

3 Complete system cleaning with materials other than muriatic acid will allow operating the system facilities without corrosion damage, will reduce down time, and keep efficiency up. Cooling systems will be cleaned without interrupting plant operations.

4 Chemical process and refinery equipment will experience less fouling as more attention is given to the technical aspects of fouling and its prevention. But once fouled, entire systems will be cleaned with organic solvent phases.

Chemical Cleaning of Preboiler Equipment..60—WA-262... By W. B. Willsey, Philadelphia Electric Company, Philadelphia, Pa. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Chemical cleaning of new steam generators has enjoyed wide acceptance for many years. Although there have been many approaches to accomplishment of the deed, the primary purpose has been to remove metal oxides and other contaminants to insure against subsequent complications that might occur should the materials not be removed.

But cleaning the steam generator alone is doing an incomplete job, the next logical step being to clean the preboiler cycle.

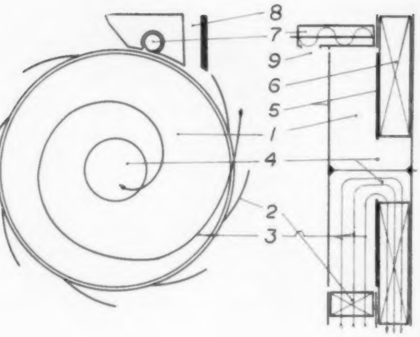
Reasons for chemically cleaning preboiler equipment are discussed, as well as some of the considerations involved in planning such a program.

Process Industries

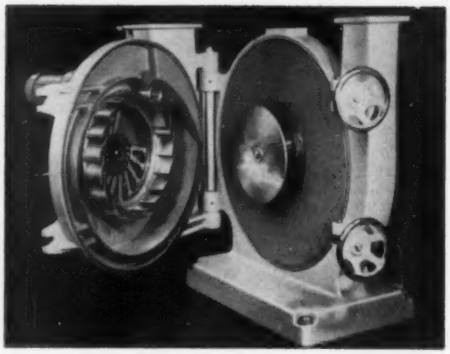
Gravity Flow of Bulk Solids..60—WA-81... By Andrew W. Jenike, Mem. ASME, Materials Handling Consultant, Salt Lake City, Utah. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Every year industry stores and handles a greater tonnage of bulk solids, and every year more automatic installations are put in operation requiring finer adjustment of the rate of feed into blending and processing, closer control of segregation, and more certain availability of the designed live capacity. In most cases gravity is relied upon to cause the solids to flow in and out of storage, and the need for knowledge in the field of gravity flow of bulk solids is increasing rapidly.

Bulk solids comprise a vast array of materials from broken rock, raw ores, grains to concentrates, chemicals, flour, salt, carbon black; they include fibers, chips, flakes; they weigh from a few pounds to a few hundred pounds per cubic foot, and range in particle size from yards to microns. Yet the behavior of all these materials in flow channels is essentially the same and the theoretical principles which are being developed seem to apply to all of them. This does not mean that there is one universal shape of bin or hopper which is best suited to all bulk solids, but it does mean that, if the flow properties of a bulk solid are correctly identified, a suitable storage



The Mikroplex Spira Air Classifier, **right.** Diagram at **left** consists of two views, the **left** showing cross section through classifying chamber, and **right,** a longitudinal section. Feed inlet (8) classifying air entering through adjustable guiding vanes (2) forms spiral path (3) through classification chamber (1) with two rotating chamber walls (5). Fine fraction and air leave chamber (4) through fan (6) into collection system. Coarse fraction leaves (9) through screw (7) (60—WA-167).



plant can be designed with a degree of certainty of satisfactory operation.

A procedure is described for the design of bins and hoppers for flow of bulk solids, such as ores, concentrates, chemicals, and foods.

Analyzing the Value in Process Engineering Commodities..60—WA-118... By W. R. Campbell, Jr., Mem. ASME, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Articles expressing concern for the rising cost of doing business are featured continually in industry and business periodicals. The headlines echo in one form or another the profit-cost squeeze which exists. They are supported by discussions of the rising cost of labor, research and development programs, and purchased commodities. The latter rising costs of purchased commodities and, in particular, engineering commodities are one target for the formal application of the technique called "value analysis" at the du Pont Company's Engineering Test Center.

Value analysis is defined as a technique for establishing the best practical relationship between required function, necessary quality, and the cost of material and equipment.

Descriptions are made of the reasons for, and point of application of, the technique of value analysis. The program of one chemical company directed at the process engineering commodities used is outlined with examples demonstrating the area of coverage and the resulting benefits.

Low-Temperature Refrigeration..60—WA-119... By A. L. Hesselschwerdt, Jr., Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The refrigeration capacity of the process industries represents a large portion of the world's refrigerating capacity presently in use. Because these industries require low evaporator temperatures, with their attendant high horsepower-per-ton requirements, and because of the necessity of continually rearranging refrigerating equipment to meet new process requirements, it is imperative that the variables affecting system performance be clearly understood.

To achieve this end, the paper presents a review of the effects of reducing evaporator temperature upon the coefficient of performance, horsepower per ton, and system capacity. The analyses are made upon both a theoretical and actual basis, thereby permitting a comparison of the two. In the case of coefficients of performance this relationship is given in terms of adiabatic efficiency, thereby supplying actual ratios which can be of use in realistic design.

The various components of the over-all volumetric efficiency are discussed and the limits for single-stage compression are established. Using actual data, it is shown that empirical expressions for the volumetric efficiency can be developed for any combination of refrigerant and compressor.

Value Analyzing for Profits..60—WA-129... By Frank Skeans, General Foods Corporation, White Plains, N. Y. 1960 Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The search for additional profits or improvements in the profit structure is the continuing objective of any business enterprise. Classically, this effort has been confined, for the most part, to improved sales of existing products, introduction of new products to exploit new markets, improved profit margins through the development of more efficient production processes and techniques, and streamlined distribution systems which facilitate product distribution at lower costs.

The lowering of product ingredient and packaging material costs is also an extremely important factor in the improvement of profit margins, but this contribution has generally been made in a relatively unobtrusive fashion, and, almost defensively, by diligent purchasing people saddled with the many pressing activities that the demands and functional requirements of their function impose.

A brief review is given of the concept as it has developed in the author's company, the organizational relationships that have been necessary and the evolution of value-analysis projects.

Air Classification and Fine Grinding..60—WA-167... By Wolfgang H. Gellrich, Alpine American Corporation, Saxonville, Mass. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Air classification of fine powders between 90 and 3 microns with excellent sharpness and efficiency has been obtained in modern classifiers, employing the principle of spiral classification. The spiral air classifiers utilize the physical forces of a vortex within a narrow cylindrical classification chamber for an extremely accurate separation of finely powdered materials into a fine and a coarse fraction. The principle and the construction of such classifiers and the effect of the classification on fine grinding are discussed.

Some Operating Experiences at a Municipal Refuse Incinerator..60—WA-235... By James D. Paulus and W. M. Harrington, Jr., Assoc. Mems. ASME, Requardt and Associates, Baltimore, Md. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Operation of a mixed-refuse incinerator produces problems of a nature not normally encountered in other methods of refuse disposal. The majority of the problems are created by the character of the refuse being disposed of and the methods of operation being utilized.

In January, 1956, the Bureau of Sanitation of Baltimore City began operating a new 800-ton-per-day-capacity incinerator located on U. S. Route 40 at the eastern boundary of the city. Before this

incinerator went into operation, the total refuse collected by the city was disposed of in a 600-ton-per-day incinerator and a sanitary land-fill operation. The new incinerator replaced the land-fill operation which had to be terminated owing to the unavailability of additional land.

The new incinerator is a pit-and-crane type and consists generally of refuse-weighing, dumping, and storage facilities; electric overhead cranes for transferring stored refuse to the furnaces; four furnaces of four cells each; two 170-ft high stacks for dispersement of the products of combustion in the atmosphere; and the necessary auxiliary equipment required for the operation.

This paper discusses some operating experiences in order that future designs may benefit from the experience gained in the operation of a municipal refuse incinerator.

The incinerator was designed with the co-operation of personnel who had been operating the existing one for many years.

Applied Mechanics

Steady-State Behavior of Nonlinear Dynamic Vibration Absorber..60—WA-14 ...By W. J. Carter, Mem. ASME, The University of Texas, Austin, Tex.; and F. C. Liu, Boeing Airplane Company, Seattle, Wash. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1961).

The Frahm-type dynamic vibration absorber is analyzed for the case where both main and absorber springs have nonlinearities of the Duffing type. A one-term-approximation solution is assumed for the motions of the two masses, and the resulting amplitude equation is solved using a graphical procedure. It is shown that the optimum dynamic-vibration-absorber system for variable frequency excitation is that which has a hardening main spring together with a softening absorber spring.

The Penetration of Hard-Steel Spheres Into Plane Metal Surfaces..60—WA-15... By Werner Goldsmith, Mem. ASME, and Peter T. Lyman, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME —J. Appl. Mech.;** available to Oct. 1, 1961).

During the past decade, increasing attention has been focused on the problems attendant to the collision of a projectile and a target in the velocity regime where penetration of the striker is shallow and, while considerable plastic deformation at the point of contact exists, pulverization and shattering of both striker and target material are absent.

The experimental investigation reported in this paper was undertaken to determine the force-indentation relations governing the contact of hard-steel balls and plane surfaces of various metals both under static and dynamic conditions, the latter involving the Hopkinson-bar technique, with maximum elastic strain rates of 500 sec^{-1}. Excellent correlation was obtained between the measured permanent crater diameter at the contact point and that calculated from strain-gage data by means of an equation treating the bar as a one-dimensional member. A comparison also was effected between the static and dynamic force-indentation curves, the Hertz law of contact, and a relation based upon the concept of a constant flow pressure in the plastic regime.

A Nondestructive Three-Dimensional Strain-Analysis Method..60—WA-16... By A. J. Durelli, Assoc. Mem. ASME, and I. M. Daniel, Illinois Institute of Technology, Chicago, Ill. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct., 1961)

Three-dimensional stress analysis has been approached so far by two methods: theory of elasticity and three-dimensional photoelasticity. Relatively few problems have been solved completely by the theory of elasticity. Three-dimensional photoelasticity, on the other hand, has found widespread application.

The method of locking-in stresses in photoelastic models and analyzing the fringe patterns in slices cut from the model is a common one and employs several techniques. These are the frozen-stress method with its ramifications, the creeping method, and the curing method. All these techniques are destructive in that they require slicing of the model. A nondestructive photoelastic technique is one using scattered light. The photoelastic method in general suffers from the limitation that it is not sufficient and requires complementary methods for the separation of stresses.

This paper investigates the possibility of a new nondestructive and complete method of three-dimensional strain and stress analysis using the embedded grid. The embedded-grid technique as developed by one of the authors employs a grid of stretched rubber threads embedded in a model made out of clear epoxy resin or urethane rubber. The method has been applied successfully in two dimensions for both static and dynamic loading.

The experimental technique of the embedded grid in three-dimensional models is developed and an application to the diametrically loaded sphere is shown. The results were compared with theoretical and photoelastic solutions available.

A New Approach to the Analysis of the Deflection of Thin Cantilevers..60—WA-17... By R. Frisch-Fay, The University of New South Wales, Sydney, Australia. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME —J. Appl. Mech.;** available to Oct. 1, 1961).

The main difficulty in the analysis of nonlinear bending is that the mathematical part of the problem points to the solution of a nonlinear second-order differential equation. Since the principle of superposition is not applicable, every combination of loads must be solved on its own.

To overcome part of these difficulties this paper proposes the "principle of elastic similarity" instead of the principle of superposition. By applying this principle a number of cases can be reduced to one basic case. This case is the vertical bar loaded at the free top by a vertical load and fixed at the bottom.

The method outlined in the solution of a cantilever under an inclined load and of a cantilever under two parallel loads can be applied for any combination of point loads. However, as the number of loads increases, the number of simultaneous transcendental equations increases too, and their solution by trial and error will become lengthy.

On the Probability Densities of the Output of Some Random Systems..60—WA-18... By Frank Kozin, Purdue University, Lafayette, Ind. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1961).

The probability density, mean, and variance of the displacement of simple linear one-degree-of-freedom systems are investigated when the spring constants and the initial conditions are random variables. The ensemble mean motion is found to be considerably different from the "mean" motion obtained by first averaging over the spring constants. Furthermore, it is found that only the first and second moments of the initial conditions effect the first and second moments of the displacement.

This approach yields the first probability density function in the phase space of the system. Hence any statistical property that can be derived from this probability function can be studied explicity. The method presented is by no means limited to the case treated.

Vibrations of Elastic Sandwich Cylindrical Shells..60—WA-21... By Yi-Yuan Yu, Mem. ASME, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1961).

In a series of recent paper theories of sandwich plates have been developed, and free and forced vibrations of sandwich plates have been investigated. It is the purpose of this paper to extend the treatment to sandwich cylindrical shells.

First, the author develops a general theory of such shells, an extension of the new theory of sandwich plates in references from which simplified equations are deduced.

On the basis of the latter equations, axially symmetric and torsional vibrations of the infinite sandwich cylindrical shell are investigated, and numerical examples are presented. As in the case of the homogeneous cylindrical shell, results for the infinite sandwich shell are also immediately applicable to the simply supported sandwich shell having a finite length.

Propagation of Axisymmetric Waves in an Unlimited Elastic Shell..60—WA-22... By A. Kalnins, Assoc. Mem. ASME, Yale University, New Haven, Conn.; and P. M. Naghdi, Mem. ASME, University of California, Berkeley, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1961).

This investigation is concerned with the propagation of axisymmetric stress waves in unlimited thin shallow elastic shells. In particular, a solution is obtained for an unlimited shallow spherical shell subjected to a harmonically oscillating concentrated load at the apex. This solution, exact within the scope of the linear theory of shallow shells, has an outward propagating wave character in the entire range of forcing frequency. Appropriate expressions for the mechanical impedance and the energy input are derived, and numerical results are obtained for the axial displacement corresponding to various forcing frequencies.

Although attention is confined here to the response of unlimited shallow shells subjected to harmonically oscillating loads, the treatment of related axisymmetric problems with the same system of differential equations is also possible. Thus the extension to a more general type of axisymmetric loading, as well as to shallow shell segments, offers no fundamental difficulties and may be carried out with the use of integral transforms in a manner similar to that for elastic plates and transverse vibrations of shallow viscoelastic spherical shells.

Machine Design

The Flexural Vibrations of Thin Laminated Cylinders..60—WA-60... By J. C. White, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

The problem of the determination of the natural frequencies of vibration of an unsupported isotropic right circular cylindrical shell has been treated extensively in the literature. Arnold and Warburton have presented solutions for isotropic cylinders with built-in and with simply supported ends, together with a considerable amount of supporting experimental evidence.

One anisotropic structure of considerable engineering importance consists of a stack of circular laminations, assembled into a cylinder. The plane of a lamination is normal to the axis of the cylinder. Each lamination has, within itself, isotropic and uniform elastic properties. The laminations consist, however, of two dissimilar materials, arranged alternately in the stack and bonded together into a solid structure.

The purpose of this paper is to present an analysis of the vibrational characteristics of such a structure. In particular, a method is developed for determining the natural frequencies of a laminated cylinder for any number of axial or peripheral nodes and for either simply supported or built-in end conditions.

The cylinder considered consists of a great many very thin laminations. It is assumed that the discontinuous structure can be replaced by a continuous structure with uniform, but not isotropic, properties. Both the actual and the equivalent structures are assumed to have linear elastic properties; in any given direction, the moduli are the same in tension and compression. The various constants of the equivalent material are derived in terms of the properties of the individual laminations. The method of analysis is that used by Arnold and Warburton.

Wear Limits for Roller and Silent Chain Drives..60—WA-8... By H. S. Germond, Assoc. Mem. ASME, Morse Chain Company, Ithaca, N. Y. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The useful life of most roller and silent chains depends on wear. A chain which appears "stretched" or elongated is merely worn at the joints by many flexures in service. This so-called wear elongation is usually stated as a per cent of original or new length. During its useful life, wear progresses until the chain refuses to run smoothly, protests loudly, or even breaks.

Wear life of a power transmission chain depends not only on how fast but how far wear may progress before the chain fails. Any one of three limitations may prevent the chain from reaching its full wear life. The paper presents an approximate analysis of each wear limit together with the field experience of the author's company. Wear limits are presented in graphical form for use in designing chain drives for maximum wear life.

Balancing Flexible Rotors..60—WA-13... By A. H. Church, Mem. ASME, New York University, New York, N. Y.; and R. Plunkett, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

Rotors operating at speeds above the first critical are difficult to balance since the centrifugal action of added correction weights creates deformations of the shaft in addition to those produced by the inherent unbalance.

This paper describes a procedure using mobility principles that can be applied to determine the magnitude and angular position of correction weights to be placed in selected planes of rotation to balance a flexible shaft or rotor.

The method is based on mobility principles and requires a minimal number of measurements. Its application to a test rotor is described, and this indicates that the method could be developed into a practical operating procedure.

Kinematics of a General Arrangement of Two Hooke's Joints..60—WA-37... By R. E. Philipp, Assoc. Mem. ASME, United States Military Academy, West Point, N. Y. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The kinematic behavior of a single Hooke's joint, based on a plane trigonometric analysis, can be found in nearly any kinematics textbook. However, the behavior of two joints is not generally considered. Inclusion of this latter topic is generally limited to a qualitative discussion of the orientation of two joints required to produce a constant angular velocity ratio of unity, but with few attempts being made to prove that such a ratio is truly achieved or that this orientation is the only one that will provide such a ratio. Those proofs, which have been found as a result of a literature survey on the subject, have assumed the conditions necessary for this constant angular velocity ratio and then proved that such conditions do satisfy the requirement.

It is the author's intent to assume no restricting conditions and to arrive at

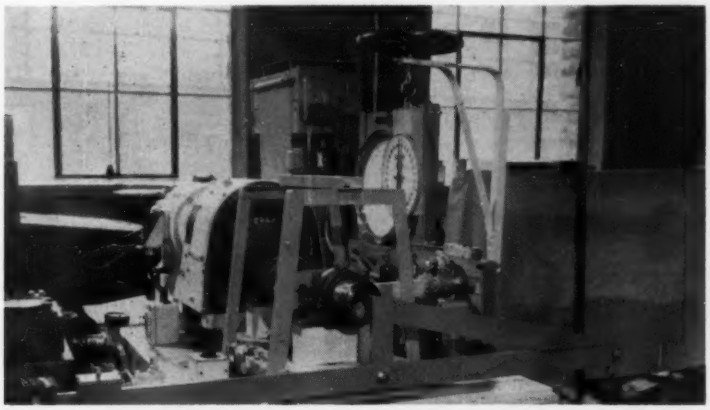
these necessary conditions by a general analysis.

The analysis is a general approach to a system of two Hooke's joints, using spherical trigonometry rather than the more common plane trigonometric approach.

The Dynamic Frictional Characteristics of Molded Friction Materials..60—WA-35... By M. J. Rabins, Assoc. Mem. ASME, New York University, New York, N. Y., and R. J. Harker, Mem. ASME, University of Wisconsin, Madison, Wis. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

A number of molded materials have been developed in recent years for the generation of high frictional forces when in contact with dry metal, the principal application being in brakes and clutches. The purpose of the present study is to obtain information concerning the frictional behavior of these materials under various conditions of loading and slipping velocity.

Data for three representative, commercially available materials are presented, as obtained from a testing procedure that enables the measurement of the coefficient of friction under varying operating conditions. The normal load, relative velocity, temperature, and surface conditions are controlled. The main conclusions of the several advanced are that the coefficient of friction decreases with increasing normal load, approaching an asymptotic value at high loads, and the value of the coefficient of friction depends upon the presence of a deposited microscopic intersurface which greatly increases the frictional capacity.



Test apparatus used in obtaining data on the dynamic frictional characteristics of molded friction materials. The equipment includes a drum, steel loading arm, wooden prony brake, and wattmeter wired to motor. Friction material is forced against the inside of the drum (60—WA-35).

Critical Speeds of Two Bearing Machines With Overhung Weight..60—WA-39... By Reyton F. Wojnowski, International Business Machines Corporation, Rochester, N. Y., and Thomas R. Faucett, Mem. ASME, The University of Rochester, Rochester, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

The purpose of this study was to determine the general frequency expression for a rotating shaft with uniformly distributed weight, supported by two bearings, and carrying a concentrated weight at the free end. The bearing spacing and the ratio of the concentrated weight to the total distributed weight have been used as parameters. The data have thus been reduced to dimensionless form so that the results are generally applicable for this type of machine. Frequencies for the first three modes of vibration have been determined and curves plotted for rapid calculation of these frequencies.

Damping Structural Resonances Using Viscoelastic Shear-Damping Mechanisms —Part I, Design Configurations..60—WA-73... By Jerome E. Ruzicka, Assoc. Mem. ASME, Barry Controls, Watertown, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

Resonant-vibration control is an important consideration when designing structures to function in a dynamic environment. The high vibration and noise levels associated with modern high-energy power sources exist over a broad frequency range. The amplification of power-source vibration by structural members creates large dynamic stresses in the structure, with high accelerations transmitted to critical components. Uncontrolled resonant vibrations result in excessive noise, structure fatigue, and component failure.

Methods of specifying structural damping are given and damping properties of engineering materials are reviewed. The disadvantages of some current design practices are outlined and special structural designs which incorporate viscoelastic shear-damping mechanisms are suggested as a method of controlling the resonant flexural vibrations of structures. The general dynamic characteristics and design philosophy of structures and strip dampers (additive damping techniques) that incorporate viscoelastic shear-damping mechanisms are discussed. A description is given of some parameters useful in the design of viscoelastic-damped structures.

Damping Structural Resonances Using Viscoelastic Shear-Damping Mechanisms —Part II, Experimental Results..60—WA-72... By Jerome E. Ruzicka, Assoc. Mem. ASME, Barry Controls, Watertown, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

The author describes the experimental dynamic response characteristics of structural design configurations employing viscoelastic shear-damping mechanisms that were discussed in the previous paper, Part I, on design configurations. Experimental results are given for cantilever beams fabricated from viscoelastic-damped sheet and structural shape members; results are also given for cantilever beams damped by use of the strip damper (an additive damping technique).

The effects of shock excitation, steady-state vibration excitation, vibration excitation level, structure resonant frequency, and environmental temperature on the damping properties of the structural design configurations are demonstrated. The effects of structural damping on the performance of vibration isolation systems are determined and the significance of employing highly damped structural designs in fabrications intended for use in modern dynamic environments is discussed.

A Tabular Collocation Method for Beam Vibration..60—WA-76... By R. Chicurel, Assoc. Mem. ASME, Virginia Polytechnic Institute, Blacksburg, Va.; and E. Suppiger, Princeton University, Princeton, N. J. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

A procedure, based on the integral equation method, is presented for the calculation of the natural frequencies of

lateral vibration of beams with variable cross section. The approximate solution is obtained by collocation. A preliminary step in the analysis is the determination of static deflection curves; this is carried out in a convenient tabular form. An example of a stepped beam is given and the results are compared to those obtained by Myklestad's method.

Stress and Strain in Spinning Paraboloid Dishes—2..60—WA-91...By M. J. Cohen, North Hampton College of Advanced Technology, London, England. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

Solutions for the stress and strain systems in spinning paraboloid dishes, both holed and whole, are presented. They are applicable to all such dishes of aperture small enough to justify the usual approximation for small angles of cos $\theta \approx 1$, sin $\theta \approx 0$. The direct stress p, the hoop stress f, the shear stress s, the bending moments M_θ and M_ϕ, and the radial displacement Δ are obtained as power series in θ, the angular distance of any point of the dish at the center of the sphere of curvature at the dish apex. These series in θ are expressed in terms of tabulated coefficients which are essentially functions of a single basic dish parameter $R\alpha^2/b$. The range for $R\alpha^2/b$ covered is $0 \leq R\alpha^2/b \leq 10$.

On the Determination of the Influence of an Axial Preload Owing to Bolting on a Cylindrical Vessel..60—WA-133...By P. R. Paslay, Assoc. Mem. ASME, Rice University, Houston, Texas. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

A thin-walled, right circular cylindrical, statically loaded, pressure vessel with two rigid end plates which are held against the cylinder ends by longitudinal elastic bolts is considered. The junction of the cylinder and end plates is assumed frictionless.

The problem is to determine the influence of the bolting preload, which is applied by the end plates on the cylinder, on the maximum pressure at which leakage is prevented. The procedure followed in this paper is to determine the lowest value of the monotonically increasing pressure that leads to a tensile longitudinal stress in the cylinder. Clearly, the first point at which a tensile longitudinal stress occurs should be interpreted as the beginning of leakage between the end plates and cylinders. It is assumed in this analysis that the initial preload does not cause yielding of the cylinder and that the elastic limit of the bolting is never exceeded.

Free Oscillations of Edge-Connected Simply Supported Plate Systems..60—WA-112...By Eric E. Ungar, Assoc. Mem. ASME, Bolt Beranek and Newman, Inc., Cambridge, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

Many practical structures, such as submarine or surface vessel hulls and aircraft or missile fuselages, are made up of plates with multiple relatively rigid reinforcements. The various subplates between the stiffeners are not likely to oscillate independently of each other in general, and the interaction of these subplates may be of major importance in determining the responses of the total structure.

The prevalence of multiple beam-reinforced plate construction has caused several investigators to be concerned with the coupled oscillation problem.

A simple semigraphical method for calculating the natural frequencies of two-plate systems is developed, a two-plate system being one made up of two rectangular plates simply supported at all edges and joined at a common edge. Charts for easy determination of the afore-mentioned natural frequencies are developed. One of these gives, as a by-product, the natural frequencies of rectangular plates (of any dimensions) having one edge clamped, the remaining three simply supported. It is demonstrated that the higher natural frequencies of two-plate systems are very nearly equal to those of the individual component plates. Equations for the mode shapes are also given.

Optimum Design of Helical Compression Springs..60—WA-215...By R. J. Erisman, International Harvester Company, Melrose Park, Ill. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

The most efficient spring, for a given application, is one that safely stores the required amount of energy and uses the least possible material. Springs designed to this premise are said to have minimum weight. Several analytical procedures, based on prescribed initial assumptions, are already available to the designer which permit the calculation of certain minimum-weight springs. In some instances the assumptions are not entirely relevant to the problem at hand; in which case, a true minimum spring is not obtained. This paper presents a solution to minimum-weight springs based on initial assumptions which can be more universally applied. Also, a solution is given to the ultimate condition where no design variables are chosen arbitrarily.

Magnetic Properties of Malleable Irons..WA-218...By W. K. Bock, Mem. ASME, National Malleable and Steel Castings Company, Cleveland, Ohio; and T. D. Hutchinson, Malleable Research and Development Foundation, Dayton, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

Standard or ferritic malleable iron is satisfactory for use as a cast, soft magnetic material. It is made by heat-treating white iron. In addition to its magnetic properties, it can be readily cast into intricate shapes and is one of the most machinable ferrous metals. By merely changing the heat-treatment, pearlitic or martensitic malleable iron can be produced from white iron.

Like all soft, magnetic materials, ferritic malleable iron is mechanically soft. On the other hand, pearlitic malleable and martensitic malleable irons are graphitic steels and exhibit a range of hardness and strength. They have the same availability as ferritic malleable and much of its machinability. Ordinarily, carbon steels are not used for magnetic applications, but because the pearlitic and martensitic malleables have the advantages outlined above, there is some idea that they might be used as a compromise by giving up some magnetic quality to gain mechanical properties. This paper supplies the magnetic properties necessary for such compromise.

Magnetically, pearlitic and martensitic malleables behave like steels if allowance is made for the graphite.

Shaft Whirling as Influenced by Stiffness Asymmetry..60—WA-252...By E. H. Hull, Mem. ASME, General Electric Company, Schenectady, N. Y. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to Oct. 1, 1961).

Using elementary apparatus and instrumentation, shaft whirling has been investigated for three cases involving round or flattened shafts in combination with uniform or asymmetric stiffness bearing supports:

Case 1 Asymmetric stiffness bearings supporting a round shaft.

Case 2 Symmetrical stiffness bearings supporting an asymmetrical stiffness shaft. (No backward whirl here.)

Case 3 Asymmetric stiffness bearings supporting an asymmetric shaft.

The type of whirl observed varies with the combination of asymmetries used. Single and double-frequency whirls have been noted, both forward and backward with respect to shaft rotation. Studies of the phase-angle changes required by running conditions have indicated reasons for whirl direction and frequency.

Hydraulics

Considerations in the Design of Extreme Range Axial Compressors..60—WA-176... By Donald O. Millar, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Not until recently were the performance characteristics of the axial compressor operating far off the design point of more than academic interest. However, with the application of the axial compressor to wind tunnels with their extreme range of pressure levels and pressure ratios, the performance characteristics at the extremes become of great interest.

This paper is directed toward the presentation of actual performance results of multistage axial compressors operating at extremes from their normal design conditions, particularly with regard to pressure ratio and Reynolds number.

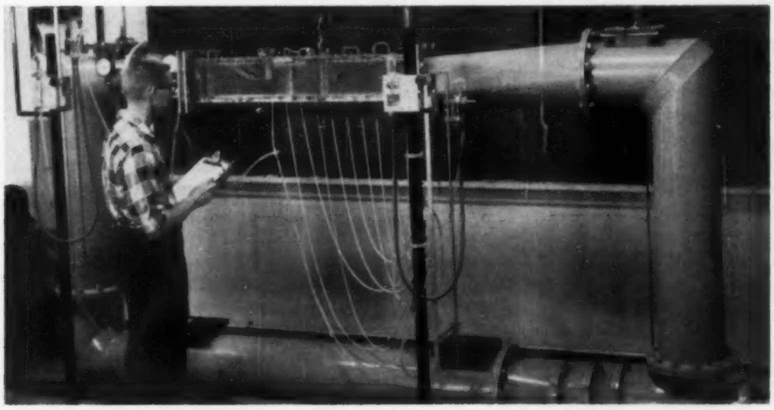
Generalization of a Class of Solutions of the Laminar, Incompressible Boundary-Layer Equations..60—WA-159... By Ward O. Winer and Arthur G. Hansen, University of Michigan, Ann Arbor, Mich. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

The momentum, continuity, and energy equations of the laminar incompressible boundary layer in a skew-linear co-ordinate system are similar in form to those in a rectangular co-ordinate system. This fact is used to generalize the requirements for similarity solutions in rectangular co-ordinates. The requirements for all possible similarity solutions of the boundary-layer and energy equations in skew-linear co-ordinates are presented. The usual Cartesian co-ordinate system is a special case of co-ordinate systems considered.

Cavitation Along Surfaces of Separation ..60—WA-265... By David W. Appel, The University of Kansas, Lawrence, Kan. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The majority of engineers concerned with various aspects of cavitation are especially interested in well-streamlined flows such as in the passages of pumps and turbines, through tunnels, over spillways, and around the propellers of ships and submerged bodies. Therefore it is natural and best that primary attention has been given to cavitation associated with these various boundary forms.

In many studies the presence of separation and the possibility of cavitation originating along surfaces of separation have been recognized. However, most of the studies reported in the engineering journals have not been concerned primarily with this occurrence. On the other hand, there has been much interest in the basic structure of flow in a zone of separation in the absence of cavitation, with much of the work in this area being of a theoretical nature. The exploratory study described here was undertaken in an attempt to bridge the gap between these two areas of endeavor. Initially, qualitative information both on cavitation and on the development of vortexes and/or turbulence along surfaces of separation was sought by direct photographic observation. Even the initial results were found to be very revealing.



The existing small recirculating water tunnel in the Fluid Mechanics Laboratory of the University of Kansas after it was adapted for close observation of flow along a surface of separation. Shown are the main ducts of the tunnel (60—WA-265).

By means of the films and this paper, the author demonstrates the development of cavitation in flow along a two-dimensional surface of separation. A description of the experiments, some views from the movie, and a discussion of the observations of cavitation in a zone of separation are given.

Use of Model to Disclose Effects of Cavitation in Penstock Wye-Branch..60—WA-153... By Horace E. Burrier, Assoc. Mem. ASME. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The Portal Powerhouse penstock has an internally reinforced wye-branch which experienced unstable flow conditions whenever there were unusually large unbalanced flows in the branch pipes.

The Portal Powerhouse is one of the eight hydroelectric plants comprising the Big Creek Hydroelectric Development owned and operated by the Southern California Edison Company. The Big Creek Development has a total effective capacity of 690,000 kw and is located in Central California, 248 miles north of Los Angeles.

A transparent wye-branch was constructed and observations made on flow conditions at prototype velocities. From these observations corrections were made in the model. The changes were then made in the prototype and satisfactory performance was realized.

Inlet Guide Vane Performance of Centrifugal Blowers..60—WA-130... By A. J. Stepanoff, Mem. ASME, Ingersoll Rand Company, Phillips, N. J. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1961).

To meet variable head-capacity requirements, single and multistage blowers are frequently equipped with guide vanes at the impeller approach. At a constant speed and at a fixed capacity, say at best efficiency point (bep), the effect of the guide vanes appears as a reduction of head and power input to the blower. At a constant head or discharge pressure guide vanes permit a reduction of the rate of flow and a reduction of the minimum or pumping capacity, accompanied with a reduction of consumed power.

The function and effectiveness of the inlet guide vanes to control the blower output and power requirements are examined. Calculated and experimental results of the power reduction by means of guide vanes are presented. The concept of the "inlet specific speed" widely used in centrifugal pump field is discussed in application to the blowers. A method of estimating the performance of single-stage blowers for any position

of the guide vanes is suggested. A "casing characteristic" is introduced for this purpose and its utility for the calculation of the impeller diameter for a reduction of the output is demonstrated. The performance of the inlet vanes of multistage blowers is reviewed.

Annual Flow of Gas and Liquid in Smooth Pipes..60—WA-161... By M. F. Abdel Aziz, Cairo University, Cairo, Egypt, UAR. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

The flow of gas and liquid in pipes can be one of the following types:

1 Bubble flow in which gas flows in the form of bubbles with nearly the same velocity as liquid.

2 Separate flow (occurs in horizontal pipes) in which gas flows on top of liquid, usually at a higher velocity.

3 Slug flow in which a slug of liquid filling the entire diameter of pipe is forced through by gas at a high velocity.

4 Annular flow in which the liquid phase is confined to a thin layer at the pipe walls while the gas phase flows at a high velocity through the central core.

The conditions that determine the type of flow and transition from one type to another are by no means clearly understood. Although we have a reasonable amount of experimental work, the complications that accompany this flow make the problem quite difficult.

This paper presents a theoretical analysis of the annular-flow type.

The Hydraulic Analogy Applied to Nonsteady, Two-Dimensional Flow in the Partial-Admission Turbine..60—WA-168... By Helge K. Heen, Eastman Kodak Company, Rochester, N. Y.; and Robert W. Mann, Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

To some extent all fluid machinery is influenced by unsteady flow conditions. In those cases where unsteady flow effects are important, the design of the flow geometry is complicated by the difficulty of creating experimental models and responsive instrumentation by which the influence of design parameters may be determined directly. Rather, recourse usually must be made to parametric experimentation on rather complete machines, determining the influence on over-all performance of systematic variations of certain parameters.

Such an indirect approach is expensive, time-consuming, and often indecisive and misleading, since the parameter of interest is entangled in a mesh of other factors which introduce a certain amount of error and "noise" in the experimental measurement. Even more important, such parametric testing usually inhibits the casual explanations which can give rise to the design inspirations provided by the *direct* observation of the flow phenomena.

This paper is concerned with the development of a technique for such direct observation of unsteady compressible fluid flow and includes an analysis of a particular flow phenomenon and the experimental correlation which confirm the validity of the observation technique. While applied here to the partial-admission turbine, the approach should prove valuable elsewhere.

Effects of Brine Dispersion in the Allen Salt-Velocity Method..60—WA-138... By L. J. Hooper, Mem. ASME, Worcester Polytechnic Institute, Worcester, Mass. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

The salt-velocity method devised by C. M. Allen and reported in 1923 has been used both in the laboratory and the field for a number of years, and during this period a considerable amount of experience has been amassed. It is proposed in this paper to discuss primarily the effects of dispersion in relatively straight pipes.

Data are presented from a variety of sources—theory, laboratory investigation, and field tests. Theory and tests show that brine injected into a conduit disperses as the square root of the distance traveled. As a result of this relationship, salt-velocity curves occupy a smaller percentage of the passage time as the test length increases. This results in smaller test errors for long test sections. Also indicated in this paper are the results of further tests which show the minimum limits for length of test sections with equipment commonly used.

Patterning State Characteristics for Wide-Range Axial Compressors..60—WA-113... By David Wilson, Assoc. Mem. ASME, Northern Research and Engineering Corporation, London, England. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

It is shown that compressors built with blade settings that result in, basically, an increasing axial velocity through the machine (that is, the reverse of the normal pattern) should give much improved low-speed stability and a wider range of high-efficiency operation. The author shows that a compressor of the suggested pattern can be built using one, or at most two, blade forms set at different stagger angles for each stage. He suggests that the advantages claimed greatly outweigh, for most industrial applications, the disadvantages of some added complication, a high diffuser-entry velocity, and an increased outer diameter.

Flow Models in Boundary-Layer Stall Inception..60—WA-149... By V. A Sandborn, Lewis Research Center, NASA, Cleveland, Ohio; and S. J. Kline, Mem. ASME, Stanford University, Stanford, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

Physical evidence on stall inception from visual studies, mean-velocity-profile correlations, shear measurements, and fluctuations in separating boundary layers in the neighborhood of stall are discussed.

Direct visual studies suggest that stall inception in the laminar boundary layer follows the classical model, but does not necessarily do so in the turbulent shear layer. It is useful to describe stall as a certain type of transition region, which can be long or short.

Adoption of these ideas is shown to lead to better correlation of stall data and more complete understanding of available physical evidence. However, physical data on the relation between the various types of evidence in the turbulent case and their respective connections with the events in the transition region leading to stall are not presently complete. This suggests experiments of a certain type which should lead to further clarification of the process of stall inception in the turbulent boundary layer.

Analog Computer Solution of a Complex Transient-Hydraulic Problem in the Power Industry..60—WA-5... By E. C. H. Taylor, University of California, Los Angeles, Calif.; A. Reisman, Assoc. Mem. ASME, Los Angeles State College, Los Angeles, Calif.; E. C. Deland, Rand Corporation, Santa Monica, Calif.; and H. H. Baudistel, Assoc. Mem. ASME, Department of Water and Power, Los Angeles, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

The Scattergood Steam Power Plant of the City of Los Angeles uses Pacific Ocean water as a heat sink. During the design of the circulating-water system which conveys the ocean cooling water to the condensers, it was necessary to predict the hydraulic behavior under certain unsteady conditions in order to establish design criteria. This article describes the circulating-water system, the problems to be solved, the methods of mathematical analysis, and the analog computer solution of the resulting set of 28 simultaneous nonlinear differential equations.

With the advent of electronic computing machinery, it has become possible to predict with speed and economy the performance of complex systems involving unsteady flow of viscous fluids. It is no longer necessary to rely upon engineering intuition or rule-of-thumb methods in such design.

The Magnus Effect: A Summary of Investigations to Date..60—WA-150... By W. M. Swanson, Assoc. Mem. ASME, Washington University, St. Louis, Mo. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

A spinning missile or body traveling through the air in such a way that the body axis of rotation is at an angle with the flight path will experience a Magnus force component in a direction perpendicular to the plane in which the flight path and rotational axis lie. The magnitude of this force is a function of the spin rate, the flight velocity, and the shape of the missile.

The Magnus force on a rotating body traveling through a fluid is partly responsible for ballistic missile and rifle shell inaccuracies and dispersion and for the strange deviational behavior of such spherical missiles as golfballs and baseballs. A great deal of effort has been expended in attempts to predict the lift and drag forces as functions of the primary parameters, Reynolds number, ratio of peripheral to free-stream velocity, and geometry. The formulation and solution of the mathematical problem are of sufficient difficulty that experimental results give the only reliable information on the phenomenon. This paper summarizes some of the experimental results to date and the mathematical attacks that have been made on the problem.

Regulation of a Hydraulic Turbine Calculated by Step-By-Step Method..60—WA-128... By Ignacy Swiecicki, Allis-Chalmers Manufacturing Company, Hydraulic Division, York, Pa. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

Many approximate formulas for determination of maximum speed and pressure changes are in existence. They are based on the assumption of a constant gate servomotor speed. For full load or any large instantaneous load change the major part of gate servomotor stroke takes place at predetermined maximum rate of travel and, therefore, the assumption of constant servomotor speed leads to reasonably good answers. When greater inertia of the water in the pipeline is involved, for more reliable results a step-by-step calculation is indicated.

Equations are developed to calculate speed and pressure transients of a hydraulic turbine during a load change. Water hammer, governor time, dashpot time, temporary speed droop, and promptness of governor response are taken into account. An example illustrates the application of equations to a step-by-step calculation.

Pressure Surges Following Water-Column Separation..60—WA-120... By J. T. Kephart, Mem. ASME, and Kenneth Davis, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1961).

In designing cooling-water supply systems for industrial plants, engineers must know whether water-column separation will occur following power failure at the pumps and, if so, what surge pressures will be attendant upon rejoinder of the separated water column. This problem becomes most acute when the water source is a natural stream subject to wide variation in surface elevation and the plant is located some distance from the pumping station on high ground.

This paper presents a method of making relatively rapid estimates of surge pressures which would result without protective devices. This method yields information valuable in answering the questions which arise during preliminary design stages of a project, such as:

1 Will a more sophisticated analysis of the problem be required for final design purposes?

2 Should provision be made in an original installation for later addition of protective devices when contemplated increases in pumping capacity are made?

3 Are rejoinder surge pressures of a magnitude which can be tolerated?

The method is valid only for systems equipped with check valves at the pumps.

Production Engineering

Performances of Carbide Tools in Machining 18-8 Stainless Steel..60—WA-1... By H. Takeyama, Government Mechanical Laboratory, Tokyo, Japan. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

The austenitic 18-8 stainless steel is one of the most troublesome materials to be machined because of the tendencies of work-hardening, high temperature, and adhesion. The ultimate object of the experiment is to establish the machining standard of the austenitic stainless steel with carbide tools based upon tool life. Generally speaking, tool life in a modern machining practice should be specified not only by the flank wear but by the crater.

This paper describes the process of obtaining the optimum cutting conditions for turning the stainless steel from the viewpoint of tool life, and discusses how the tool life is governed by flank wear and crater depending upon the cutting conditions.

An Experimental Investigation of the Electrolytic Grinding Process..60—WA-2... By Reno R. Cole, University of California, Los Angeles, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

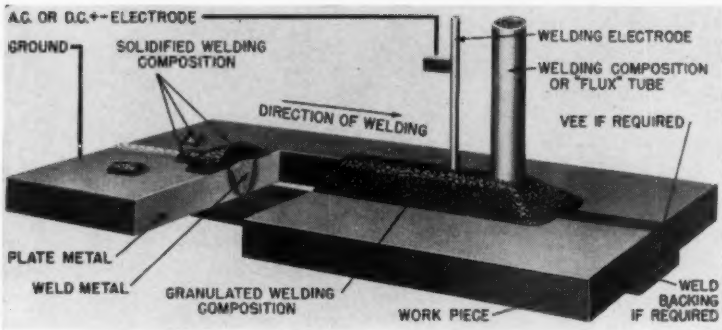
Data are presented covering the effect of several variables on grinding rate for the electrolytic grinding process. The relative amount of material removal due to electrolysis and due to conventional grinding action was investigated. The Faraday current efficiency of the electrolytic part of the process was found to be near 100 per cent to the extremely high current density of 700 amp per sq in. This is thought to result from the scraping action of the wheel abrasive which prevents passivation of the work anode.

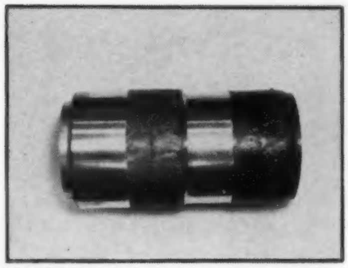
Several phenomena of the process are explained on the basis of hydrogen gas pressure in the work-wheel interface. A formula is presented for calculating the hydrogen gas pressure. Equations are proposed for the basic chemical reactions of the process.

New Development in the Theory of the Metal-Cutting Process; Part II—The Theory of Chip Formation..60—WA-63... By P. Albrecht, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

An introduction of the concept of ploughing into the metal-cutting process leads to the abandoning of the assumption of collinearity of the resultant force on tool face and on the shear plane. With this understanding the tool face force is found to produce a bending effect causing bending stresses in the shear zone. Study of the chip formation mechanism when varying cutting speed showed that increased bending action reduces the shear angle, and vice versa. A setup for the development of an analytical model of the chip formation process based on the combined effect of shear and bending stresses in the shear zone is given.

Application of the gained insight to the design of the cutting tool for maxi-





Stainless-steel overlays on a 4-in diam, heavy-wall carbon steel pipe, done by submerged-arc welding (60—WA-324)

Details of submerged-arc welding process, in which a continuously fed bare-wire electrode is melted under a bed of granular flux.

mum tool life by controlling of the chip-tool contact is suggested. A brief introduction to the study of cyclic events in chip formation and their relation to the tool life is presented.

An Experimental Investigation of Temperature Distribution at Tool-Flank Surface..60—WA-87... By B. T. Chao and K. J. Trigger, Mem. ASME, University of Illinois, Urbana, Ill.; and H. L. Li, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

The measurement of temperature distribution at the flank surface of a cutting tool is characterized by the extremely small extent of the surface over which the temperature field is explored. This paper describes a technique which makes use of a moving lead-sulfide, photoconductive, infrared radiation detector. The surface in question is quickly scanned by the detector's view field. For the level of temperature encountered, data are reproducible and the method may be used to determine temperature distribution over sliding contacts in general. From the measured flank surface temperatures, tool-chip interface temperature distribution was deduced using geometrical, electric analog.

The technique also has the general application in finding steady temperatures at locations which are not accessible for direct measurement. The computed tool-chip-interface temperature profile agrees well with known crater-wear patterns. Tool-face frictional force calculated from thermal considerations compares favorably with independent dynamometer measurement.

Arc Welding for Overlaying Steel..60—WA-324... By R. B. Hitchcock, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

Overlaying by welding differs from the long-practiced surfacing processes in that it is normally applied to provide resistance to corrosion rather than to abrasion, impact, or wear. Therefore the materials used for overlaying are basically corrosion resistant, and the final chemical analysis of the weld deposit—rather than hardness or some other property—is of major concern.

Surfacing is usually performed on small items, such as tractor rollers, knives, dies, dredger teeth, screw flights, and conveyers; overlaying applies to large surfaces such as tanks, rolls, and drums. For surfacing, metal-arc, oxyacetylene, and various spray-coating processes are used. Overlaying, as discussed in this paper, is accomplished by the submerged-arc and inert-gas-shielded consumable-electrode welding processes.

Other investigators of weld overlaying have developed procedures for depositing the maximum number of pounds of weld metal per hour. It is the purpose of this paper to describe initial studies of the variables involved in the submerged-arc and gas-shielded welding processes as they are applied to overlaying, with the objective of understanding the role of these variables in the production of sound, corrosion-resistant surfaces.

Free Machining Steel; III—Cutting Forces; Surface Finish and Chip Formation..60—WA-111... By M. C. Shaw and P. A. Smith, Mems. ASME, and E. Usui, Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Winter Annual Meeting paper; (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

Tests upon a variety of friction sliders reveal that, contrary to common belief, manganese sulfide is a poor solid lubricant relative to air. Lead, on the other hand, is found to be an excellent solid lubricant. An analog tool is introduced to enable surface finish studies to be made in the absence of feed marks.

Cutting force results are presented for a wide variety of cutting conditions for both resulfurized and leaded steels. The built-up edge and thermal softening along the tool face lead to complex curves of cutting force versus speed. Additions of sulfur are found to promote the formation of a small built-up edge that is stable to much higher valves of speed than that normally experienced with a nonresulfurized steel. Lead, on the other hand, tends to prevent built-up edge formation.

Both lead and sulfur are found to produce thinner chips, promote chip curl, and to give rise to a shorter contact length between chip and tool. A discussion of the significance of the observed changes in contact length will be found in part 4 of this series.

On the Mechanics of Wire Drawing..60—WA-114... By C. T. Yang, International Business Machines Corporation, San Jose, Calif. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1951).

Split-die technique was adopted to find the coefficient of friction in wire drawing directly from experiment. Simple dynamometers with wire resistance strain gages were used for measuring separating force and drawing force instead of cumbersome equipment used by former researchers. Reasonably good results were obtained.

The effect of the land or parallel portion in the die on the coefficient of friction was indicated in the results. Its importance was emphasized.

A theoretical equation of the drawing stress with the effect of land considered was derived. Using the coefficient of friction obtained by the split-die method, drawing stresses were calculated from the derived equation. A comparison of the theoretical and experimental drawing stresses was made. Results were tabulated and plotted.

It was concluded that including the land in the analysis of wire drawing is important and further research in analyzing the shear deformation must be pursued in order to get a close agreement between theoretical analysis and experimental results.

A Theory of Shear Spinning of Cones.. 60—WA-134... By S. Kobayashi, and E. G. Thomsen, Mem. ASME, University of California, Berkeley, Calif.; and I. K. Hall, Pratt & Whitney Aircraft Company, Hartford, Conn. 1960 ASME Winter Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1961).

A blank can be transformed into a cone by the shear spinning process. In this process all elements at certain radii from the axis of rotation remain in their respective positions during deformation. The principal deformation process is assumed to be one of simple shear, and hence the name shear spinning is derived from such assumption.

The theoretical deformation mechanism of shear spinning of cones is re-evaluated. It is found that the predicted tangential or power spinning forces for commercially pure aluminum and lead for several spinning conditions agree well with the experimental data. In addition, the normal force and axial force components are evaluated and fair agreement between theory and experiment achieved.

The Plasma-Arc Torch—Five Years of Evolution..60—WA-311... By R. M. Gage, Linde Company, Division of Union Carbide Corporation, Newark, N. J.; and J. F. Pelton, Linde Company, Indianapolis, Ind. 1960 ASME Winter Annual Meeting paper (multilithographed; available to Oct. 1, 1961).

As introduced to industry in 1955, the modern plasma arc was first used for the cutting of aluminum. Since then, its evolution has been interrelated with its physical characteristics and limitations as a new tool. The modern plasma arc is hotter than the hottest chemical flame, but much less intense than the electron beam. Commercial uses of the plasma arc in the field of metalworking are well established and consist of constricted tungsten-arc cutting as well as plasma-arc platting. These are discussed, as well as welding, weld surfacing, metal heating, and other important but specialized applications being established.

Fuels

New Concepts—Coal From Mine to Industrial Boilers..60—Fu-4... By C. E. Day, Jr., Mem. ASME, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del. 1960 ASME-AIME Fuels Conference paper (multilithographed; available to August 1, 1961).

Solutions are offered to the problem of reducing investment and operation costs for industrial coal-fired boilers. The author calls for concentration on methods already tried and proved effective, but not widely accepted.

Some steps that could be taken in the future for more effective use of coal are discussed, including possibilities for marketing coal ash, the impracticability of maintaining large coal reserves, and the extra cost to the coal-fired plant resulting from the variance in time for rail movement from mine to plant.

ASME TRANSACTIONS

The January, 1961, issue of the Transactions of the ASME—*Journal of Engineering for Power* (available at $1.50 per copy to ASME Members, $3 to nonmembers) contains the following:

The Radial Turbine, for Low Specific Speeds and Low Velocity Factors, by E. M. Knoernschild. (59—A-294)

Design and Development of a Convective Air-Cooled Turbine and Test Facility, by W. F. Weatherwax. (59—A-282)

A New Runaway Speed Limiter for Kaplan Turbines, by G. H. Voaden. (59—A-103)

Vibration of Water-Turbine Draft Tubes, by Mitsukiyo Murakami. (59—A-96)

Charts for Determining Size of Surge Suppressors for Pump-Discharge Lines, by C. W. Lundgren. (59—A-73)

Simplified Instrumentation and Field Checking of Hydraulic Turbine Governors, by B. E. Wheeler. (59—A-124)

Field Testing and Adjusting of Hydraulic Turbine-Generator to Improve System Regulation, by H. M. Stone. (59—A-149)

Field Adjustment of Hydraulic-Turbine Governors, by C. L. Avery. (59—A-108)

Design of Suction Piping and Deaerator Storage Capacity to Protect Feed Pumps, by R. S. Thurston. (59—A-20)

Centrifugal Pumps Used as Hydraulic Turbines, by C. P. Kittredge. (59—A-136)

Cavitation in Centrifugal Pumps With Liquids Other Than Water, by A. J. Stepanoff. (59—A-158)

Thermal Instability in High-Speed Gearing, by W. P. Welch and J. F. Boron. (59—A-118)

Advances in Steam Turbines for Marine Propulsion, by A. D. Somes. (59—A-263)

Decentralized Peak-Shaving—Its Economic Significance to Electric Utilities, by C. W. Bary. (59—A-283)

Recent Improvements in Load Capacity of Large-Steam-Turbine Thrust Bearings, by H. C. Bahr. (59—A-139)

Acoustic Attenuation and Relaxation Phenomena in Steam at High Temperature and Pressure, by D. D. Eden, R. B. Lindsay, and H. Zink.

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COMMENTS ON PAPERS

New Welding Processes for Difficult to Weld Applications

Comment by Arthur R. Lytle[1]

The author of this paper[2] has presented an excellent dissertation, both generally and in some desired detail, of the many new processes and techniques that can be used to join or weld metals and other materials. He is uniquely qualified through long experience in the field to make this presentation and to critically appraise the various processes.

My particular interest in discussing the paper is to supplement it, with a little different emphasis. The welding engineer, considered as a broad technologist responsible for all aspects of welding, has shown a laudable enthusiasm for reaching out into the newer sciences for means of solving his problems. Several of the author's examples illustrate this and, in some specific instances, this has been the only recourse available to solve the complex problems. However, in the broader picture, I believe that the principal problems of the future in respect to utilization of structural metals will not be solved so much by new processes as they will by radical advances in metallurgical and engineering science. The author touched on these in his introduction and I only want to emphasize them.

The new structural metals, and within this category I am including all load-bearing structures, can develop the full potential of their high mechanical properties in engineering structures and assemblies only if they are welded. Without welding, a factor reflecting the means of joining must be employed, but with welding, the assembly becomes a continuous structure, the properties of which may be fully equivalent to those possessed by the original material. The fact of a continuous structure, however, imposes new and serious problems which are almost independent of the welding process used. We, for instance, must learn how to handle stress and the accompanying strain in a complex structure; how they are transmitted and distributed; we must understand how residual stress develops and expresses itself in a welded structure and what is the effect of two and three dimensions on the ability of a particular metal to undergo plastic or even elastic strain. Over the years we have learned how design fits into this picture and have been able to circumvent many of the difficulties introduced by the continuous nature of these welded structures. But there is a pronounced trend toward the new metals and especially the new high-strength steels. These are compounding our troubles because to use them profitably we must load them to a higher percentage of their inherent capacity for, say, plastic deformation. Active research along these lines has been and is under way under the auspices of such competent and interested agencies as the Welding Research Council Ship Structures Committee, several agencies of the Government, ASME through the Boiler Code Committee, and the like.

The successful solution to this type of problem probably will require entirely new concepts in metallurgical and design engineering. It is because of this situation that the welding engineer eagerly seeks and appraises each potential new process, hoping that he will receive major assistance or hopefully a new method of attack that will be applicable to his objective of being able to weld all metals and alloys successfully.

[1] Senior consultant, Electric Welding Department, Linde Company, Division of Union Carbide Corporation, New York, N. Y.

[2] J. J. Chyle, "Welding Processes," MECHANICAL ENGINEERING, vol. 82, May, 1960, pp. 43-47.

Comment by Adolph Vlcek, Jr.[3]

The author has briefly but comprehensively covered the existing technology on the subject of welding processes supporting his written text[2] with illustrations which assist in explaining and clarifying the techniques and facilities involved.

From the standpoint of an aerospace company these new welding processes are of great importance. Normally there are a number of ways of doing a job and our only concern is choosing the most economical method. But in today's technology such is not the case—we are searching for a method—any method that will enable us to do the job. Because of this condition it is more important to the aerospace industry to develop new methods rather than improve old ones.

A majority of the welding processes described have been fully developed and are currently utilized in production operations. However, in my opinion, a few are still pretty much in the development stage and will require considerably more development before they can be accepted as production processes.

Electron beam welding is one requiring further development—primarily in bringing it from the laboratory to production status. The vacuums required for this type welding are not easily provided for complex or large structures such as we will most likely be concerned with in applying this welding concept to space vehicles. Radiation hazards would also preclude any idea of placing an operator within the vacuum chamber without suitable protection. Remotely controlled manipulators, similar to those used in handling radioactive material, will be required to answer this problem.

Refinements to the foil-seam welding concept could possibly overcome the problem of porosity in welds which would then make this process applicable to space vehicles where zero leakage is mandatory.

The ultrasonic welding process is among the most promising of the new

[3] Director of manufacturing, The Martin Company, Baltimore, Md.

processes for difficult to weld applications in the electronics and missile fields. As the author stated, substantial progress already has been made in developing this new process as a production tool for joining metals. It is expected that ultrasonic welding will become one of the most widely used joining processes in future missile and space-vehicle fabrication.

All of the types of varied brazing operations mentioned by the author have been utilized by the Martin Company at one time or another. The die-quench and quartz-lamp techniques were mainly R&D programs whereas the furnace and electric-blanket operations were semi-production. The use of Al_2O_3 as a braze-filler addition has been exploited by Martin to the point whereby a braze filler has been developed using 0.5 to 1 per cent Al_2O_3 and the remainder silver. This alloy, starting in powder form, was produced in 0.005-in. gage foil and subsequently evaluated in tests. The dispersion-hardened alloy has been evaluated versus silver-lithium in wettability and shear strength. In regards to wettability the dispersion-hardened alloy is sluggish, thereby creating uniform fillets on top and bottom faces of honeycomb core. The shear data indicated a 6000 psi difference in strength of the dispersion alloy over the silver-lithium.

The future potential of honeycomb brazing is unlimited with the complexity and geometry of missiles and rockets always changing with the increasing temperatures and the weight requirements decreasing. Thus the need for steel honeycomb and subsequently refractory metal honeycomb is boundless.

Above all, I feel that the author's discussion of the need for new processes is particularly significant when we take into consideration the new, unfamiliar materials that are required today and the vastly different environments they will be subjected to.

Also his treatment of the evolution of these welding processes from the Egyptians up to today is interesting. But today, just as the author points out, the competition is so stiff that we do not have 25 or 50 years to develop the new processes that are needed. We are committed to get vehicles and men into space in the next ten years and to do that we must perfect our welding processes much earlier than ten years. Also, the concept of sending a space platform up in components and then assemblying it up there requires that we have a method of joining these components in the environment of space. So the problem is one of urgency, for time is our most limiting factor.

Comment by F. G. Harkins[4]

The author has performed a real service in assembling in a single package[2] a description of most of the recent developments in weld technology and equipment.

A sage once said that: "There is nothing new under the sun." The internal-combustion engine in the 1960 automobile does not differ in principle from that of the 1892 model. Similarly, many of the so-called "new" welding processes are extensions of existing techniques necessitated by the development of high-strength, high-temperature, low-temperature, and other special purpose alloys. Even the alloys themselves are compounded from familiar materials.

For the most part, the special welding processes have been developed as answers to specific problems. For example: The arc plasma or plasma jet can be directly related to the atomic hydrogen process of the early 1930's. The electro slag appears to be an extension of the submerged arc process which came into general usage about 30 years ago.

It is not intended to convey the impression that the recent developments in welding processes are not significant, but rather to point up that, in many cases, new processes are logical extensions of existing technology.

Of the processes discussed in this paper, it appears that those most likely to find wide commercial usage are:

1 Ultrasonic Welding. This tool is invaluable for the economical fabrication of thin foils. The lack of a heat-affected zone is a substantial achievement. Add to this the welding of materials which were formerly considered to be unweldable—such as 2024 aluminum alloy—and the value of this process becomes apparent.

2 High-Frequency Resistance Welding. This process opens new vistas in the fabrication of large-diameter, thin-walled tubing and similar applications. Conventional tube-manufacturing methods usually involve a relatively heavy-walled structure which is subsequently reduced by draw bench or related operations. The development of this process allows welding of the tubes to actual size and thickness at remarkably high rates of speed.

3 Foil-Seam Welding. Many of the objections to resistance lap seam welding and mash welding are overcome by this process. The offset loading of the lap welds and the "built-in notch" of the mash weld are eliminated. Being a pressure-welding process, many of the inherent defects of fusion-welding processes such as porosity and internal defects are minimized. Micrographs of the weld structure show a fine grained dendritic pattern as opposed to the coarse grained pattern of conventional seam welding. Weld height and penetration is easily and accurately controlled so that the stress-distribution pattern becomes ideal for applications requiring high-joint efficiencies.

4 Electron-Beam Welding. This process will hardly find extensive commercial usage due to high initial cost of equipment and low-production rates. Where highest quality weldments are essential to the successful function of the part, or where refractory metals must be joined, the electron-beam process should be considered.

The processes and techniques described in this paper are indicative of the enormous strides which are being made in the metals-joining field. New concepts and extensions of existing methods are being developed and marketed almost on a daily basis. The use of electronic control equipment has gone far to insure reproducibility and further improvements may be expected in the immediate future.

[4] Chief process engineer, Solar Aircraft Company, San Diego, Calif.

Author's Closure

The author is indebted to Messrs. Lytle, Vlcek, and Harkins for their excellent comments on this paper. Some interesting additional points were brought up, and these will be discussed under the headings of the various commentators.

A. R. Lytle. Mr. Lytle has brought up an interesting point regarding the utilization of the structural materials, particularly those for load-bearing-types. He indicated that the factor reflecting the design is an important one, with which the author fully agrees. Distribution of the complex stresses is an important point, and I certainly agree that in this field more attention should be given to same. Where high-strength carrying members are to be joined by welding, particular attention should be directed to the design, and to place the welds in the most advantageous locations so that they will be in the least critical areas. Stress concentrations due to mechanical notches or changes in sections are complex and particularly difficult to analyze. This factor will become increasingly more important with the newer refractory and reactive metals, some of which have properties that are useful at high temperatures. As pointed out by Mr. Lytle, the metallurgical aspect of these alloys, as well as of the weld metal, is of vital importance, and more information in this area should be obtained.

A. Vlcek, Jr. Mr. Vlcek has presented an interesting comment on today's prob-

lems in the fabrication of missiles, aerospace component parts, and satellites, which require the study of new welding processes which have not as yet been developed. This is an area which will require the co-ordinated efforts of scientists, solid-state physicists, and metallurgists. This area is beyond the realm of solution by a welding technician.

Of interest also is Mr. Vlcek's comment that today there seems to be some limitations which must be considered in the wide spread adoption of electron beam welding to these newer materials.

Fortunately, developments are continuing in this area, and breakthroughs in this type of equipment have been made, indicating that heavy sections can be welded at relatively low voltages, without the hazards due to the x rays which are given off. Mr. Vlcek also pointed out some of the advancements made by his company, which are of value in brazing some of these newer materials.

F. G. Harkins. Mr. Harkins brought out the fact that some of these newer welding processes are modifications or improvements on some of the older processes.

In fact, if the entire field of welding could be condensed into groups, these would consist of pressure welding, fusion welding, and brazing. All processes could be logically classified under one of these three groups. However, the development of some of the special processes does require the talents of highly specialized scientific men, particularly physicists, metallurgists, and engineers who are able to utilize the most recent developments in their fields. For example, electron-beam welding requires a highly scientific approach, since it involves low vacuum and electrical equipment of a highly specialized nature.

Mr. Harkins also points out that there are four welding processes which are most likely to find wide commercial usage, and the author is entirely in agreement with this.

The old adage, "There is nothing new under the sun," is true, and many of these most interesting and challenging new adaptations have been developed by our scientists.

John J. Chyle.[5]

[5] Director of welding research, A. O. Smith, Milwaukee, Wis.

An Engineer Looks at Human Behavior

Comment by Gerald H. Hutton[6]

In concurring in Mr. Grasse's conclusion as developed in his paper,[7] that the salvation of our society lies in the mind of the engineer, I should like briefly to compare the professional attitude of the technologist with that of the politician. The function of the former, I take it, is to discover and develop ways and means for the public benefit, while that of the latter is to organize and harness such means to suit the public taste.

The line dividing these objectives is clear. On the one side we have unadulterated facts as far as it has been feasible for the engineer to reveal them. On the other, we have the same facts cooked and garnished as far as it has been expedient for the politician to prepare them for public implementation. Now the public is notoriously susceptible to persuasion and propaganda while being convinced of personal interest in an issue which must be ethically annoying to the engineer.

In the case of the politician, behavior may involve demonstration of partisanship, emotion, hysteria, prejudice, jealousy, and like passions. Buffoonery at conventions and waving of arms to crowds are tolerated by society as normal procedure. On the other hand, the current exchange of slanderous charges between opposing party members is generally disapproved.

A few pertinent suggestions to the politicians follow:

1 Keep propaganda away from convention and council chambers.

2 Acknowledge manifestations of the crowds with as much dignity as possible.

3 Remember television. Maintain balance and sobriety.

4 Take care that your behavior cannot be used by foreign nationals as undermining the principles of democracy.

5 Decide whether the President should drop party politics after election and whether he should employ the best men regardless of party prejudice.

The engineer does not appear to have much to worry about in the matter of behavior. Of the 11 influences on over-all production enumerated by the author, the question of loyalty may be the most provocative in this land of individualism.

Operating policies are laid down under overhead direction and subject to political considerations to which the engineer in line of duty is expected to conform. Ethical issues are inevitable and the engineer has sometimes to ask himself whether he should resign, or file a disclaimer of responsibility, or merely keep his mouth shut. And there may be the natural temptation for the younger engineer to give a little push to the older engineer's retirement or unemployment.

Problems of this sort will respond mostly to disinterested advice.

On the whole, engineers do not appear hysterical, emotional, or fearful of the machinations of such individuals as Castro, Hitler, or Khrushchev since the public may be prepared to take in stride an increase in taxes, if necessary, for defense purposes.

A few salient suggestions for engineers follow:

1 Keep politics out of technology.

2 Consult disinterested advice toward solving problems of behavior

3 Add a new slogan to the code somewhat as follows: "There is no task, however humble, but dignifies the doer if well done."

[6] ME, U. S. Navy, ℅ Resident Officer in Charge of Construction, San Francisco, Calif. Mem. ASME.

[7] Harold Grasse, "An Engineer Looks at Human Behavior," Mechanical Engineering, vol. 82, August, 1960, pp. 34-35.

Comment by Victor Paschkis[8]

I read this article[7] with great interest. I think that the author is right; that it is conceivable that human action follows certain laws. In making this statement he assumed, undoubtedly, cause-and-effect relationships comparable to those occurring in the physical universe.

Is it not possible that the same laws which all great religious leaders have expressed in "do and don't" terms are actually cause-and-effect laws?

It is quite an interesting exercise so to transcribe the well-known moral laws with which we are familiar. A suggestion for such an analogy counters the objection that, apparently contrary to the prediction of the moral law, evil often prevails. A possible answer to this objection is that a time lag occurs which may be quite long, possibly even longer than a life span.

But time lags are, of course, also known in the physical universe. We need only remember the observation of a time lag in temperature in heating up a furnace; or the time lags in control systems.

If this hypothesis is accepted as a basis for experimentation and if we are truly concerned for our progeny, most remarkable conclusions regarding our behavior would follow.

[8] Professor, mechanical engineering, and director, Heat and Mass Flow Analyzer Laboratory, Mechanical-Engineering Department, Columbia University, New York, N. Y. Mem. ASME.

Air Heater for 3000 R, 600 PSIA

Comment by Robert T. Schroth[9]

The heater described in this paper[10] probably represents the pioneer effort in the application of thermal storage-type heaters to supersonic wind-tunnel use. The paper, itself, should provide a basic reference for those engaged in the design of high-temperature, high-pressure air-heating sources for aerodynamic test facilities. Much of the information presented has already been made available to the Naval Ordnance Laboratory (NOL) and to others working in the field of aerothermodynamics. The staff of the Polytechnic Institute of Brooklyn has been most co-operative in freely discussing their work with the NOL in the past, and their generous exchange of information on this subject is acknowledged.

As the author suggests, the use of direct-fired combustors can be considered as a means of regenerating the heat-storage bed, and he cites several instances in which this method has been applied successfully. A combustion-type pebble-bed storage heater has been constructed at NOL. Although it operates at a delivery air temperature of only 1500 R, it has a storage, in terms of total air-handling capacity at constant delivery temperature, of about 30,000 lb. This can be compared to a figure in the neighborhood of 1100 lb of air in the case of the Brooklyn heater. Fig. 1 is a photograph of the installation, and Fig. 2 is a schematic of the equipment. In regenerative heating systems where the total air-handling capacity is large and regenerating times are short, a direct-fired combustion system is competitive with, if not preferable to, the electrical system, both from the standpoint of initial cost and operation. In the NOL heater the equivalent of 3000 kw is supplied during regeneration. The initial cost of the propane gas storage, supply, and combustion system was about $50,000. The cost of an electric load and control center, alone, to supply the same power would have been upward of $60,000. The additional cost of the heater elements coupled with the increased mechanical complexity would make this scheme unattractive in our design. Moreover, electrical energy may run as high as twice that of fuel gas. Maintenance might be somewhat more expensive for the gas-fired unit, but this is open to question. Admittedly, these costs will vary with the size, temperature, and pressure of the installation, but it appears that the general trend is to favor the gas-fired system as the heater increases in size. That temperatures in the region of 3500 R can be achieved without harmful contamination of the air has been demonstrated, at least on a pilot basis, by several agencies working in this field.

In considering the physical size of the heater bed for a given temperature and pressure it is obviously not sufficient to look at the cost variation with bed diameter without stipulating the total air-heating capacity, which is directly related to the bed volume. A preliminary analysis of the cost of a pebble-bed storage heater for operation at 200 atmospheres and 3500 R has been made to show the trend in cost of the heater as a function of pebble-bed diameter for several fixed volumes of heat-storage material. It was assumed that the bed porosity was 45 per cent, that the thickness of the insulating refractory was the same in each case, and that the ineffective length of the heater was constant in each instance. A working stress of 30,000 psi was used for the pressure-containing vessel and the wall thickness determined according to an empirical solution for laminated thick wall cylinders. The results of this analysis are presented in Fig. 3. The curves display a more or less pronounced minimum depending on the volume of the bed. The trend, however, in all cases is to indicate a sharp decrease in cost with increasing bed diameter up to about 2 ft-0 in., and a slowly rising cost thereafter.

This analysis was carried out to include vessel diameters which are somewhat larger than those that are commercially available at present. Due to the growing interest that industry has shown in producing large-diameter, high-pressure vessels, it is not unreasonable to project the curves into this region, however. Of immediate interest is the fact that the cost actually dimishes for bed diameters up to 2 ft-0 in. for a 20 cu ft bed volume. This is the case which nearly corresponds to the Brooklyn heater. Although this

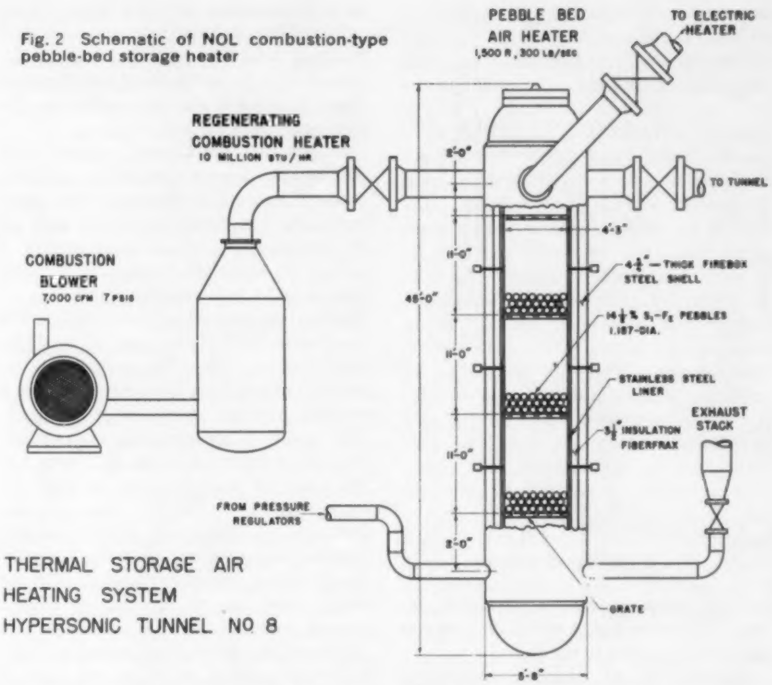

Fig. 2 Schematic of NOL combustion-type pebble-bed storage heater

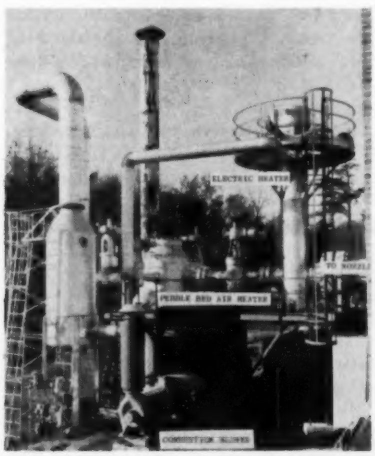

Fig. 1 Combustion-type pebble-bed storage heater constructed at NOL

[9] Supervisory research engineer, Aeroballistic Research Department, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md. Mem. ASME.

[10] Martin H. Bloom, "Air Heater for 3000 R, 600 PSIA," MECHANICAL ENGINEERING, vol. 82, August, 1960, pp. 40–42.

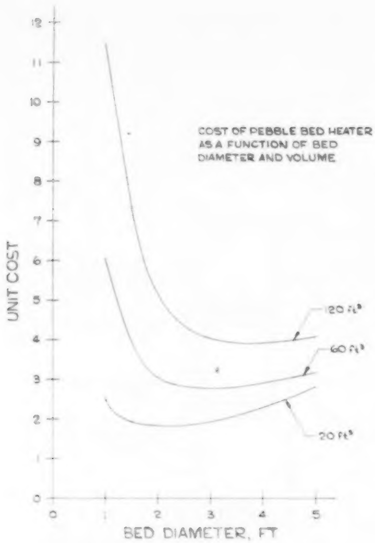

Fig. 3 Results of analysis

analysis assumed a constant pressure, the effect of greater design pressures is merely to shift the curves to the right.

Calculation of the pressure drop through the pebble bed of the NOL heater was based on a percentage of fill of 60 per cent whereas the measured value was 57.3 per cent. The bed diameter to pebble diameter ratio was approximately 43. Since the porosity fell within the 35-45 per cent range the experimental formula for pressure drop found in Perry's "Chemical Engineers' Handbook," 1950 edition, was considered applicable. Testing of the NOL storage heater is incomplete at this time, but preliminary measurements show fair aggreement with the computed values.

A final remark on the selection of the thermal-storage material may be in order. Neglecting the mechanical properties and thermal-shock characteristics at elevated temperatures; i.e., considering purely thermal properties, a good starting point in the selection of a suitable material appears to be to determine those materials that combine a high specific weight—specific heat product $(W \cdot C)$ with high thermal conductivity (k) in the temperature range of interest. For a given rate of heat release or weight flow, a minimum value for the thermal conductivity and a minimum specific weight can be established and the choice narrowed to a consideration of the $W \cdot C$ product. It is interesting to note that the range of values of this product for most solid materials, metals and refractories included, is comparatively narrow, in the order of 50 per cent of the least value, whereas the spread of values of either of the properties is about 7:1. As a consequence, the heat capacity per unit volume is relatively constant and material selection will be largely determined by the mechanical and chemical characteristics of the material at the desired temperature level.

In general, the thermal conductivity will assume greater significance with increasing pressure of the air-heating cycle, especially for those materials, such as the refractories, which have a low k value. In the NOL heater the ratio of the gas-side heat-transfer coefficient to thermal conductivity was sufficiently small that the k of the material could be neglected entirely. The method of regeneration can also determine whether k of the material must be considered. The gas-fired regenerating systems ordinarily operate at low pressures, in the order of 5 to 20 psig, so that, irrespective of the pebble material, the h/k ratio is small and pebble thermal conductivity does not contribute significantly to the total heat transfer. On the other hand, in an electrically heated system, in which thermal radiation is an important factor, the k values will usually be a determining factor in the rate of regeneration. Regenerating time for the NOL heater is about three hours when the total heat release has been 7.5×10^6 Btu, the condition which prevails when the delivery temperature is on the threshold of becoming time variant

Comment by W. D. Lanier[11]

The subject paper[10] has assumptions in Section 3, Design Calculations, which are believed to be incorrect. A pebble bed designed on the basis of these assumptions will be fluidized at the rated capacity. The following suggestions are submitted for consideration:

The actual force acting on a pebble-bed segment is the pressure difference across the segment times the total bed cross-sectional area.

Therefore, equations (2) and (3), page 8 of the original paper, should read:

[11] Project engineer, Norman Engineering Company, Los Angeles, Calif. (Presently with Beckman Instruments Inc., Fullerton, Calif.)

$$(P_1 - P_2)A < W(X_2 - X_1)(A - \alpha) \quad (2)$$

$$-dp/dx < W\frac{(A-\alpha)}{A} \quad (3)$$

In the example, page 9 of the original paper

$$-dp/dx = 163 \text{ pcf}$$

Since

$$W\frac{(A-\alpha)}{A} = 244\,\frac{(3.14 - 1.51)}{3.14} = 127 \text{ pcf}$$

the bed will lift prior to rated flow conditions (neglecting pebble mechanical friction).

The validity of the afore-mentioned was borne out experimentally by the Sandia Corporation as reported in:

SC-4354 (TR) AEC Research and Development—Aerodynamics TID-4500 (15th Edition) D. E. Randall, 5142 and S. S. Millwright, 5142.

In this experiment the bed fluidized when:

$$(-dp/dx)/\rho_b \sim 1.0$$

where

$$\rho_b = \text{Bulk Density} = \frac{W(A-\alpha)}{A}$$

Author's Closure

The author agrees with Mr. Lanier's modification of the pressure gradient criterion. In usual operation the heater described in the subject paper supplies a nozzle with a 1.50 in. diam throat, thus delivering 10 lb/sec at stagnation conditions of 3000 R and 600 psia, and 12 lb/sec at 2000 R and 600 psia. The maximum pressure gradients under these conditions are about 100 pcf or less.

Also note typographical errors in Eq. (4): On first line, exponent of $(wVb/6n)$ should be -0.1; on second line, terms containing ϵ should read $[(1-\epsilon)/\epsilon]^{1.1}(1/\epsilon^2)$ as plotted in Fig. 4.

Martin H. Bloom.[12]

[12] Professor, Aerodynamics Laboratory, Polytechnic Institute of Brooklyn, Freeport, N. Y.

Inspecting Taper Threads—A New Technique

Comment by Stuart L. Nisbett[13]

This paper[14] presents an interesting break-through in the analysis of screw threads that has laid dormant much too long. The ability to readily determine the truth of the effective pitchcone, roundness, and constancy of the helix angle has always been limited and each forward step deserves encouragement by all concerned.

It is believed the difference between the plug and ring gages and other instrumentation can stand emphasizing. The plug and ring are basic functional gages

[13] Member of Faculty, General Motors Institute, Flint, Mich.

[14] A. A. Mittenbergs and Ned Rodgers, "Inspecting Taper Threads," Mechanical Engineering, vol. 82, August, 1960, pp. 43–46.

that either accept or reject the composite geometry of the screw threads. This type of gage is still the ultimate in final inspection even though it is slow and awkward. However, when the geometry of individual elements of the screw thread require investigation, specialized measuring machines such as the one described here make up the backbone of analytical metrology.

Probably the most illusive of the screw thread geometrical elements has been the constancy of the helix angle, otherwise known in less refined environments as "drunken threads." There are relatively few instruments capable of a satisfactory analysis of this important characteristic and it is good to welcome an instrument into the field that includes this faculty as one of its several capabilities. Another feature of special value in this instrument is the chart record it makes of its measurement. Many more subtle variations of basic geometric form can be captured, studied, analyzed, and evaluated than is possible with vibrating dial hands of one type or another.

It must be recognized that in its present or initial form this instrument has rather limited application. It was created to satisfy the special needs of measuring threads used in oil-well drilling. When the broad scope of screw threads is viewed, the area occupied by the pipe threads used in oil-well drilling form a small though colorful spot in the picture. In fact, this discussion writer at first found it difficult to focus clearly on this group of screw threads for they are so far outside the experience of engineer's thinking in terms of general manufacturing requirements. Looking up some American Petroleum Institute tables it was found the screw threads for which this instrument is specifically designed to measure are American National Taper Pipe Threads from $2^3/_8$-5 to $6^5/_8$-4. This range includes about six or possibly eight sizes of threads. It must be remembered that the instrument was successfully developed to measure a few sizes of threads, the smallest of which is $2^3/_8$ in. in diameter. With this size of nominal diameter goes the corresponding coarse threads of only four or five to the inch with substantial thread flanks. A mental picture of this instrument in its present form attempting to measure a $^1/_8$-27 taper pipe thread or a $^1/_2$-20 NF-2 thread becomes a bit ridiculous.

The next step in the development of this instrument should be to make it applicable to the vast range of thread sizes used in the general manufacturing world. It is recognized this presents some frustrating problems but the basic idea is too good to keep it locked up in such a small or limited field of application.

As it is viewed through this paper there are a few extremely critical design problems that must be solved in the process of development. No doubt these would uncover many more problems not readily recognized at this point.

The shaft driving the master lead screw from the rotating drum prevents the measurement of threads on anything but a hollow part with a generous inside diameter. Considering the number of threads on solid stock, a redesign should be made to eliminate this interfering shaft in its present position.

The problem of concentrically locating the threaded part in the rotating drum is a serious one and not too satisfactorily solved in the present instrument. Personal observations have not revealed a thread cutting machine of any kind that locates the cutting dies from the surface that is to become the thread major diameter for external threads or minor diameter for internal threads. Except where centers are used, the part is generally chucked either longitudinally behind the threaded section for external threads or upon the peripheral surface of the stock containing the internal threads. To be sure, such surfaces are seldom qualified as a datum surface for subsequent gage location. It would seem at first glance that a better location for gaging would be from the pitch line of the thread. Alignment rings similar to the ones illustrated in Fig. 5 of the paper except with spherical balls locating on the pitch line of the thread would accomplish the desired positioning. There would have to be three balls each on the upper and lower rings spaced 120 deg apart radially. The balls would have to have a longitudinal freedom adequate to compensate for the helix angle and any variations from its normal path. Also, the balls would have to be the correct size for the pitch thread being measured. This means the alignment rings must be designed for quick interchange of a large variety of ball-locating attachments.

Also, as the finer threads and higher classes of fit are accommodated, it is believed the 0.0001 in. mechanical dial indicators would be entirely inadequate for measuring the concentric positioning of the thread. Either electric or electronic indicators or comparators would have to be employed.

The massiveness of the carrier (item 4 in Fig. 4 of the paper) imparts the idea of high inertia even if made from magnesium and counterbalanced. The area of contact of the slideway on the guideway would also present a substantial friction. The combination of forces means the stylus riding in the thread has an appreciable resistance to overcome to move the carrier. A fine thread could be damaged by scoring or by the groove resulting from the impressive deflection caused by the stylus pressure.

An instrument that would be practical for general thread measurement would need to be constructed to a unitized design. Master lead screws of various pitches must be capable of being quickly slipped into place for the screw being checked. Similarly, alignment rings as previously discussed must be readily inserted. Stylus units for the various pitches and for both internal and external threads must be readily slipped into positive locating, self-locking positions. Finally, carrier guideways and slideways must be capable of angular adjustment to permit the measurement of both taper and straight threads.

Although the economic aspects of such a development would petrify the stoutest hearts, there is no doubt that the screw-thread industry needs an instrument of this capability for the evaluation of screw threads in general. It is hoped sincerely a way will be found to permit the further research and refinement necessary to accomplish this end. The authors are certainly to be complimented on their significant accomplishment in this field.

Authors' Closure

The authors wish to thank Mr. Nisbett for his penetrating comments, constructive suggestions, and kind compliments.

It should be pointed out that acceptance of a taper thread by a plug or ring gage guarantees an acceptable thread only if all the various thread-element errors are sufficiently small. Taper threads containing large-element errors and accepted ("gaged") by plug and ring gages may give a quite different thread fit than that predicted by the gages when the mating parts are screwed together. This fact is particularly critical in shouldered taper-thread connections.

The first Tedar machine was constructed primarily for research purposes. This may explain its limitations. In its original form, it can measure only the API (American Petroleum Institute) $4^1/_2$-in., full-hole, tool-joint threads that have five threads per inch and a three-in. per ft taper. Use of a central drive shaft was convenient for this particular application and so were the aligning rings shown in the paper. As Mr. Nisbett points out, neither of these expedients is usable for general applications.

The principles of the technique described are applicable to the broad field

of both cylindrical and taper threads. The authors believe that suitable equipment can be developed for just about any kind and size of threads. However, they do not share Mr. Nisbett's opinion that unitized design accommodating all sizes and types of threads would be practical or feasible. Rather, machines or apparatus should be developed each accommodating a certain range of thread sizes and/or types, suitable for some certain part configurations and range of sizes of the parts involved. It is difficult to conceive a thread-inspection machine that would inspect, for example, large threads on a heavy part and at the same time be capable of inspecting small precision screws. Equipment for the latter, of course, should be of much smaller size and built to higher precision.

The authors sincerely appreciate Mr. Nisbett's interest and contribution to this subject and agree with him that further research and development of this technique are necessary before it can be fully utilized.

A. A. Mittenbergs.[15]
Ned Rodgers.[16]

[15] Project leader, mechanical engineering department, Battelle Memorial Institute, Columbus, Ohio. Mem. ASME.

[16] Chief engineer, Flexweight, Inc., Great Bend, Kan.; formerly director of engineering, American Iron and Machine Works Company, Subsidiary of American Machine and Foundry Company, Oklahoma City, Okla.

Who Should Manage Engineers?

To the Editor

Mr. Warren's article in the September, 1960, issue of Mechanical Engineering, "Who Should Manage Engineers," is most stimulating. The following comments are submitted as a contribution in maintaining impetus along Mr. Warren's line of thought.

It may be that an important term has been left out of the phrase "responsibility, remuneration, and recognition," namely—"authority." This is important and is not entirely solved by the modern concept that an engineer with initiative will assume the required authority or be given it quasi-official. The point missed in recent engineering-management literature is the close relationship between official authority and recognition. The recent so-called shortage of engineers has presented a problem to the individual engineer and the engineering profession, which is not apparent, but can have serious consequences in the near future on the security of this country; namely, the infusion into responsible engineering administration of unqualified technically incompetent people, whose "status quo" and security depends on perpetuating the scientifically unfounded theory that engineers are a different breed of human being unqualified for administration or supervisory positions. What is the old cliche "it takes one to know one." Perhaps, engineering management problems in this country can be traced in part to the lack of technical engineering in management. The author's comments on "a priori technique" are appropriate. It would be interesting to speculate or estimate what effect, psychologically, these prejudices or self-evident assumptions have had on engineers' management aspirations in the years past.

Dean J. Darrow.[17]

Author's Closure

The author believes Mr. Darrow's comments are entirely pertinent. His suggestion that proper authority should go with responsibility should not have been overlooked. It is quite probable that these "a priori assumptions," which are actually not in accord with much of present day practice have had an adverse effect upon the management opportunities open to engineers.

G. B. Warren.[18]

[17] Senior Flight Test Engineer, Convair Astronautics, San Diego, Calif. Assoc. Mem. ASME.

[18] Retired vice-president, General Electric Company, and consultant, Turbine Division, Schenectady, N. Y. Past-president and Fellow ASME.

Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Fifty Years of Progress in Management

Fifty Years' Progress in Management

Oliver J. Sizelove and Marshall Anderson, coeditors. Published by The American Society of Mechanical Engineers, New York, N. Y., 1960. Cloth, $8^1/_4 \times 11$ in., figs., index, 329 pp., $10.50, with a 20 per cent discount to ASME members.

Reviewed by M. J. Murphy[1]

[1] Vice-president, Smyth & Murphy Associates, Inc., New York, N. Y. Affiliate, ASME.

Coeditors Sizelove and Anderson and their Advisory Committee deserve high praise for their efforts in preparing and publishing this unusual book. As members of the Executive Committee of the Management Division of ASME, the coeditors have been intimately aware of the Management Division's past practice of publishing successive reports each decade entitled "Ten Years' Progress in Management," following in the path of the late Dr. Leon P. Alford, who prepared the first such report back in 1912.

However, in addition to securing the contributions of distinguished management authorities on progress in management in the 1950–1960 period (in itself a substantial volume), the editors also have brought together the previously published reports covering the

four previous decades. Thus we have a uniquely useful volume which provides us with a 50-year perspective of management philosophies and techniques.

The volume is well organized and handsomely presented. Symbolizing the golden anniversary theme, the cover is of gold. The pages are large ($8^1/_2 \times 11$) and the use of a two-column format makes for good legibility despite the rather small type size used. The 1950–1960 report is presented first, and the earlier reports follow in reverse order, back to 1912. (For those who may be worried about the dates, the Management Division wisely decided to shift the reporting cycle over to a calendar-decade basis. As the editors correctly comment, "The two-year overlap of the two latest reports is hardly discernible in this field.")

The caliber of the contributors and of their contributions is generally extremely good. Dr. Lillian Gilbreth once again heads the list. "Dr. Lillian," now in her 80's, is still vigorously looking ahead, as she was when she wrote the foreword to the ten years' report published in 1952. She and W. L. Jaffe have written a stimulating chapter on "Management's Past—A Guide to Its Future."

Lyndall Urwick (Management Philosophy), H. F. Smiddy (Management as a Profession), Alex W. Rathe (Measurements and Control), H. B. Maynard (Manufacturing Management), and Peter F. Drucker (A Look Back and a Look Forward) have all written outstandingly good contributions. Of particular interest to ASME members is the section on Professional Societies, written by C. E. Davies. His long association with ASME and his current responsibility as Executive Director of the United Engineering Center Project make him a well-known figure within the Society.

In all, there are 19 sections to the 1960 report, and it is by far the largest and most complete to date. However, the real contrasts with earlier years lie not so much in length or in the variety of subjects covered, as in the sharp differences in emphasis and sophistication that show up. The 1960 report, for example, introduces for the first time a separate section on "Management Science," by E. H. Weinwurm. In it, Weinwurm reviews some of the more striking developments of the past decade in decision theory, organization theory, operations research, information theory, and data processing. Much of the review still emphasizes the promise of the future rather than the successes of the past, but the impression remains strong that the promise is closer to realization than even dreamed possible ten years ago. Other contributors also have highlighted the growth of "management science" as a factor. In particular, H. K. Hyde's section on "Practices in Operational Management—The Federal Government" points up the considerable progress made by the federal government, alone or in concert with the private sector, in the exploitation of science and technology in decision-making, information handling, and related management processes.

Equally interesting is the contrast between the sense of newness, of awareness of "something different" which shows up in the early writings, and the sense of solid acceptance of management as a separate discipline which we see today. Drucker states this well in his section on "Fifty Years of Management—A Look Back and a Look Forward," when he writes:

"This new insight, this new concept of managing as something specific, suddenly arose around 1910. In the next ten years between 1910 and 1920, the great decade of the first World War, every single one of the great themes of management is struck... Management, as a specific discipline, as a specific kind of work, as a specific function in society and economy, was developed, almost entirely, within the past fifty years."

These 50 years of which Drucker speaks are the same years covered by this volume. It should therefore be a valuable guide to anyone concerned with sensing the shape of management's future from the patterns of its past.

BOOKS RECEIVED IN LIBRARY

Engineering Economy

By William T. Morris. 1960, Richard D. Irwin, Inc., Homewood, Ill. 506 p., $6^1/_4 \times 9^1/_4$ in., bound. $10.50. To present engineering economy with the larger context of the analysis of management decisions, this book devotes the first nine chapters to "nearly all the ideas . . . traditionally included in engineering economy." These include managerial economics, taxes and replacement policy, and engineering decisions, covering fundamentals, the obtaining of alternatives, sources of information, production and judgment, and evaluating intangibles. The remainder of the book introduces ideas from operations research, management science, and decision theory, including probability and game theory, decisions under risk, under certainty, and under pressure, policies of inventory, bidding and purchasing, statistics, diversification, simulated decision making, and the economics of automation.

Extractive and Physical Metallurgy of Plutonium and Its Alloys

Edited by W. D. Wilkinson. 1960, Interscience Publishers, Inc., New York, N. Y. 314 p., $6^1/_4 \times 9^1/_4$ in., bound. $10.50. Based on the 1959 San Francisco symposium sponsored by committees of the Metallurgical Society of the AIME. W. D. Wilkinson of the Argonne National Laboratory contributes a special "Introduction to Plutonium Metallurgy," and a 44-page annotated bibliography. Six papers on the extractive metallurgy of plutonium include discussion of conversion of salts and reduction of halides to metal, preparation of metallic plutonium and halides, and removal of fission product elements. Eight papers on the physical metallurgy of plutonium include discussion of alloying behavior, plutonium-cerium and plutonium-zinc phase diagrams, etching, zone refining, and alpha, beta, and gamma plutonium.

Fuel Cells

Edited by George J. Young. 1960, Reinhold Publishing Corporation, New York, N. Y. 154 p., $6^1/_4 \times 9^1/_4$ in., bound. $5.75. This volume contains the papers and subsequent panel discussion heard at a 1959 Symposium sponsored by the American Chemical Society. The nine papers include a general introduction to fuel cells, and discussion of high and low-temperature hydrogen-oxygen fuel cells, carbonaceous fuel cells, the electrode processes in fuel-gas cells, molten alkali carbonate cells, catalysis of fuel-cell electrode reactions, and electrode kinetics of low-temperature hydrogen-oxygen fuel cells.

Gmelins Handbuch der Anorganischen Chemie, 8th Edition
System No. 3 Sauerstoff (Oxygen)
Lieferung 4.

Published 1960 by Verlag Chemie, Weinheim, Germany. 366 p., 7×10 in., paper. $53. The 4th Oxygen section treats in successive chapters Air, Active Oxygen, and Ozone. Under "Air" this portion of the Handbook describes solely the physical properties. "Active Oxygen" includes information on formation and preparation and on chemical reactions. "Ozone," prefaced with a historical review, devotes considerable space to formation and decomposition, and only a few pages to preparation. Under physical properties the structure of the molecule is accorded special interest. Under mechanical and thermal properties it is noted that the literature data hitherto used should be regarded as obsolete, in view of recent measurements which have been made since the previous cut-off date.

Graphite and Its Crystal Compounds

By A. R. Ubbelohde and F. A. Lewis. 1960, Oxford University Press, New York, N. Y. 217 p., $6^1/_2 \times 9^1/_2$ in., bound. $5.60. This survey includes description of current lines of research without attempting definitive treatment where these are considered to be premature. It covers crystallographic models and structure of graphite, its physical, thermal,

and electronic properties, and its crystal compounds and their electrical and chemical properties and chemical physics. The final two chapters discuss graphite oxide, and the chemical transformation of graphite to volatile products. There is a 28-page bibliography.

Handbuch des Kokereiwesens

Edited by Otto Grosskinsky. 1958, Karl Knapp Verlag, Düsseldorf, Germany. 541 p., $7^1/_4 \times 9^1/_2$ in., bound. DM 86.00. This second volume of the Handbook of Coking Practice discusses by-product recovery and gas purification on a broad scale. The first three chapters deal with the classical methods of by-product recovery, and chapters 4 to 9 with the modern processes developed in coking practice. Finally, one chapter each is devoted to the utilization of clean gas as a raw material, flow circuits for gas treatment, and the economics of such coke and by-product production.

Information and Decision Processes

Edited by Robert E. Machol. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 185 p., $6^1/_4 \times 9^1/_4$ in., bound. $5.95. A volume based on a 1959 Purdue University Symposium on Information and Decision Processes, including two of the outstanding papers from the 1958 Symposium. The 12 papers include discussion of computation in decision making, sequential design of experiments, models, sequential decisioning and tests, Markov chains in probability theory, coding theorems, group testing in a binomial sample, subjective probability, and statistical decision theory in engineering.

Infrared Radiation

By Henry L. Hackforth. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 303 p., $6^1/_4 \times 9^1/_4$ in., bound. $10. This book presents information on the components of infrared radiation units and the laws of physics by which they operate. It then outlines the applications and potentialities of infrared in science, medicine, technology, and industry. A generalized infrared system is developed step by step from the source of the signal through the methods of transmission to the final display. The latest material on infrared artificial sources, research in wave-length transmission, infrared instruments, detectors, and spectroscopy is given.

An Introduction to Linear Programming and the Theory of Games

By S. Vajda. 1960, John Wiley & Sons, Inc., New York, N. Y. 76 p., $5^1/_2 \times 8^3/_4$ in., bound. $2.25. This is an elementary British treatment of two mathematical techniques fundamental to Operational (Operations) Research. Linear programming is dealt with mainly as a simple numerical method, examining the transportation problem, graphical representation, the Simplex Method, complications and their resolution, and duality. The theory of games is evolved from the basis of linear programming and includes discussion of normalization, graphical representation, nonzero-sum games, more person games, and infinite games.

Introduction to the Statistical Dynamics of Automatic Control Systems

By V. V. Solodovnikov. 1960, Dover Publications, Inc., New York, N. Y. 307 p., $5^1/_2 \times 8$ in., paper. $2.25. This version of a translation of the original 1952 Russian work, edited to remove errors of terminology and of style, constitutes a self-contained exposition of the principles of the analysis of linear systems, the statistics of random signals, and the theory of linear prediction and filtering. It does not contain discussion of specialized contributions to the theory of filtering and prediction made since 1952.

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Low-Temperature Techniques

By F. Din and A. H. Cockett. 1960, Interscience Publishers, Inc., New York, N. Y. 216 p., $5^3/_4 \times 8^3/_4$ in., bound. $6.50. This work of British authors intends to provide a source of up-to-date information about the principles and practice of low-temperature techniques, emphasizing the practical aspects. Sources are not given, but reading recommendations reflect international publications. The book discusses the geographical and historical background, the production and measurement of low temperatures, low-temperature techniques in the lab, the properties of materials at low temperatures, gas separation, and the storage, transport, and uses of liquefied gas, particularly in industrial refrigeration.

Malleable Iron Castings

Published 1960 by the Malleable Founders Society, Cleveland, Ohio. 526 p., $6^1/_4 \times 9^1/_2$ in., bound. $10. Change of title indicates complete rewriting of this book's predecessor, "American Malleable Iron—A Handbook," to encompass the results of research, the new manufacturing methods introduced, and the better production equipment developed since 1944. The book discusses the history and the physical, mechanical, and engineering properties of malleable iron, its machining and metallurgy, and the various types, uses, design, and manufacture of malleable iron castings. Two chapters give special attention to pearlite malleable iron and alloyed malleable iron.

The Manufacture of Iron and Steel, Vol. 3: Steelworks Fuels, Furnaces, Refractories, and Instruments

By G. Reginald Bashforth. 1960, Chapman & Hall, Ltd., London, England. 246 p., $5^1/_2 \times 8^3/_4$ in., bound. 35s. The 1959 revision of Vol. 2 of the original work necessitated a third volume to accomodate the large amount of new material involved. Thus Vol. 1 deals with iron production, Vol. 2 with steelmaking processes, and the new Vol. 3 discusses open hearth fuels, liquid fuels, and producer gas; the open hearth furnace, plant, and equipment; and instrumentation and refractories in steelmaking plants. Written by a British author connected with Banaras University in India, the book draws on international sources for material, illustrations, and examples.

Materials Selection for Process Plants

By R. E. Gackenbach. 1960, Reinhold Publishing Corporation, New York, N. Y. 318 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.50. This handbook contains data on the mechanical properties, fabrication characteristics, and corrosion-resisting qualities of metals, plastics, rubbers, paints, and cements for use in process equipment. The emphasis is on the prevention of corrosion, and the various types of corrosion and their prevention are first presented. The author then outlines information on the properties and applications of iron, steels, plastics, rubbers, chemical-resistant cements, paints, and alloys of nickel, copper, aluminum, lead, and titanium, gathered from his own experience, from literature sources, and from manufacturers' catalogs.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting Nov. 4, 1960, and approved by the board on Dec. 6, 1960.)

Annulment of Cases

Case 1055-1

Provisions of Case now included in Addenda to Section VIII.

Case 1122-7

Provisions of Case now included in Addenda to Section VIII and Case 1274N-3.

Case 1213

Provisions of Case covered by revisions to Specifications SA-182.

Case 1198

Provisions of Case now included in Addenda to Section VIII.

Case 1188-1

(Special Ruling)

Copper-Chrome-Nickel

Add to the Inquiry:

and castings which meet the requirements of ASTM Specification A296 (latest revision) in all respects except that the composition shall be ACI Type CN-7M of following chemical and physical requirements:

Carbon, max, per cent	0.07
Manganese, max, per cent	1.50
Silicon, max, per cent	1.50
Phosphorus, max, per cent	0.04
Sulphur, max, per cent	0.04
Chromium, per cent	19.00–22.00
Nickel, per cent	27.50–30.50
Molybdenum, per cent	1.75– 2.50
Copper, min, per cent	3.00
Iron, per cent	Balance
Tensile strength, min psi	62,500
Yield strength, min psi	29,000
Elongation in 2 in., min per cent	35

Add to the Reply the following:

(10) Castings of the ACI Type CN-7M described may be used under the above applicable provisions for service in the temperature range of 20 to 300 F and with the following maximum allowable stresses at the metal temperatures shown:

−20 to 200 F	300 F
15,600 psi	15,000 psi

Case 1204-6

(Special Ruling)

Quenched and Tempered Steel

Revise Item (12) of the Reply to add "and stiffeners" after structural attachments.

Add a new Item (21) to read:

(21) *External Pressure*

(a) The required thickness of shells or heads shall be determined from the chart in Fig. UCS-28.3.

(b) The required moment of inertia of stiffening rings shall be determined from the appropriate chart in the Code for the material used in the ring or from Fig. UCS-28.3 if made of low alloy steel covered by this Case. (Fig. UCS-28.3 will be included in Case Interpretations sheet.)

Case 1241-2

(Special Ruling)

Carbon Steel Forgings SA-105

Inquiry: Is it permissible to use carbon steel forgings to Specification SA-105, Grade II, for construction conforming to Sections I and VIII as modified by the following requirements?

(a) *Heat-Treatment* Heat-treatment may consist of accelerated cooling and tempering.

(b) *Mechanical Properties* In addition to the requirements of Specification SA-105, Grade II, the Brinell hardness of those parts on which tensile tests are not made shall not exceed 187 BHN.

For material over $3^1/_2$ in. in thickness a deduction from the percentage of elongation in 2 in. specified of 0.5 per cent shall be allowed for each increment of $^1/_2$ in. above $3^1/_2$ in. This deduction shall not exceed 3.0 per cent.

(c) *Inspection* All surfaces shall be inspected for injurious defects by magnetic-powder or penetrant-oil methods.

Reply: In the opinion of the Committee, carbon steel forgings made to Specification SA-105, Grade II, as modified in the Inquiry may be used for construction conforming to Sections I and VIII of the ASME Boiler and Pressure Vessel Code with the following additional requirements:

(1) Welding procedure qualification in accordance with Section IX shall be performed on test plates of this material subjected to the same heat treatment before and after welding as will be used in fabrication.

(2) Material subjected to accelerated cooling as outlined in (a) of the Inquiry shall not be subject to the prohibition of welding as outlined in Pars. UF-5(c) and UF-32(a), or to the heat treatment required by Par. UF-31(b) after all repair welding is completed.

Case 1272N-2

(Special Ruling)

Containment and Intermediate Containment Vessels

Add a new subparagraph as follows:

(6) ***Welded Attachments:*** All attachment welds to pressure parts except round studs up to and including $^3/_8$ in. diam shall be welded using a qualified procedure used for welding shell joints of the vessel. Material used for nonpressure parts, permanently welded directly to pressure parts of impact tested material, which are not subsequently stress-relieved shall also be of similar impact-tested material. This material shall extend 16 times the attachment weld thickness beyond the vessel wall before other material shall be attached by welding. Other Code materials (except those of structural quality and SA-53 pipe) in the P-1 Group of Table UCS-23, up to and including $^1/_2$ in. thickness, may be welded to impact-tested shell material provided the weldment is stress-relieved.

Case 1273N-4

(Special Ruling)

Nuclear Reactor Vessels and Primary Vessels

Inquiry: Under what special rules shall a nuclear reactor vessel or a primary vessel, as defined in Case 1270N, be built in order to be acceptable for Code construction?

Reply: Pending development of more complete rules to cover nuclear vessels, it is the opinion of the Committee that a reactor vessel or a primary vessel shall meet the requirements of this Case in order to meet the intent of the Code and to be stamped in accordance with Case 1270N. Where differences exist the requirements of this Case take precedence over the Code rules for the subjects covered. The requirements of this Case are:

(1) The thickness of each part of the vessel shall not be less than that determined by the Code rules using the applicable formula for the part with S values from the appropriate table in Sections I or VIII.

(2) The combination of stresses evaluated under item (1) with thermal stresses due to temperature distributions at any level of steady power operation, including internal heat generation, shall not exceed $1^1/_2$ times the S value.

(3) For operating metal temperatures up to 800 F, the maximum allowable bolt design stresses as used in Code formulas may be based on heat treated properties for operating metal temperatures 100 F or more below the tempering temperature, provided the stresses do not exceed $^1/_3$ of the yield strength at temperature.

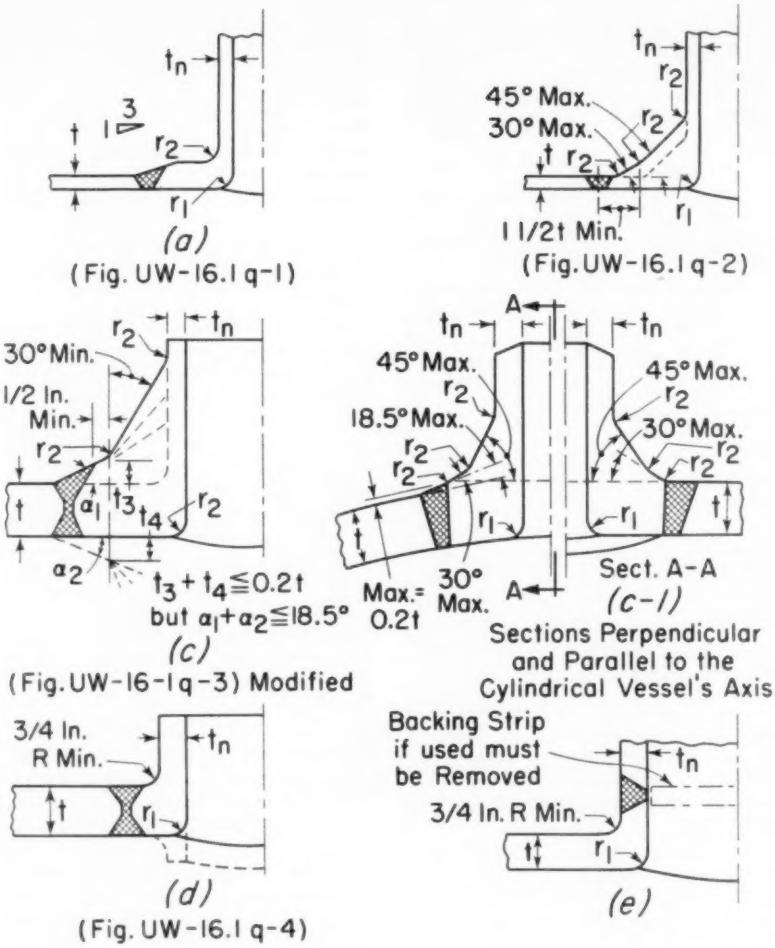
(4) (a) Due regard shall be given to the creep and stress-rupture properties for prolonged exposure at temperature in order to assure adequate safety under all conditions of operation.

(b) Each design detail shall be carefully considered to provide against operational failure such as might occur from thermal stress, external pipe reactions, or control rod drive shock.

(5) Compensation shall be made for all openings regardless of diam. Compensation shall be on either the reinforcement basis or the ligament efficiency basis as given in Section I or Section VIII. Any compensation required shall be integral with the vessel wall or the nozzle or some with each. Properly deposited and inspected weld material may be included as part of the compensation.

(6) Attachment of Nozzles or Other Connections

(a) General—Nozzles or other connec-



Note:

t = Thickness of Part Penetrated

t_n = Thickness of Penetrating Part

t_c Min. = $0.7t_n$ or 1/4 In. whichever is Less

r_1 Min. = 1/4t or 3/4 In. whichever is Less

r_2 = 1/4 In. Minimum

Fig. 1 Acceptable welded nozzle attachments readily radiographed to Code standards

tions shall be attached to the shell or head of the vessel by one of the methods given in this Case.

(1) It is the intent that full penetration welds as shown in Figs. 1, 2, and 3 be used, except as otherwise provided in 6(a)(2) and 6(a)(3), for the purpose of achieving continuity of metal and facilitating the required radiographic examination. When all or part of the required compensation is attributable to the nozzle, the nozzle shall be attached by full penetration welds through either the vessel or the nozzle thickness or a combination of both including any weld metal used for compensation.

(2) Non-full-penetration welds as shown in Fig. 4 are allowed only for attachments on which there are substantially no piping reactions, such as control rod housings, pressurizer heater attachments and openings for instrumentation and on which there will be no thermal stresses greater than expected in the vessel itself. For such attachments, all compensation shall be integral with the part of the vessel penetrated. Non-full-penetration welds shall be of sufficient size to develop the full strength of the attachment.

(3) Radiography of seal welds is not required.

(b) ***Butt Welded Attachments***—Nozzles may be attached by full penetration butt welds through either the vessel or the nozzle wall as shown in Fig. 1. The butt weld shall be so located that it may be radiographically examined to the standards in Par. UW-51 or Par. P-102.

(c) ***Full Penetration Corner Welded Attachments***—Nozzles as shown in Fig. 2 may be attached by full penetration welds through either the vessel or nozzle wall.

(1) Nozzle attachment in accordance with Fig. 2, Sketch (k) shall be examined to the radiographic standards of Par. UW-51 or Par. P-102. The radiography of this detail is recognized as requiring special techniques, including multiple exposures, and these techniques shall be subject to the approval of the inspector.

(2) Nozzles attached in accordance with Fig. 2, Sketches (f), (g), (h), (i), (j) and (j-1) shall be radiographically examined to the radiographic standards of Par. UW-51 or Par. P-102 and the special radiographic techniques required shall be subject to the approval of the inspector. In addition, the fusion zone and the parent metal beneath the attachment surface shall be ultrasonically inspected after welding to assure freedom from lack of fusion and laminar defects. The ultrasonic inspection and the standards in quality shall conform to Case 1275N.

(d) ***Attachment of Connections Using Deposited Weld Metal as Compensation***—Built-up weld deposits may be applied to either the vessel or the nozzle wall provided the deposited weld is radiographically examined to the standards in Par. UW-51 or Par. P-102 before assembly. Nozzles may then be attached by full penetration welds through either the vessel or the nozzle wall as shown in Fig. 3. This weld attachment shall be so located that it can be radiographically examined to the standards in Par. UW-51 or Par. P-102 and, prior to fabricating the vessel, the manufacturer shall demonstrate to the satisfaction of the inspector the adequacy of the radiographic technique. Whenever a weld is attached to a plate surface as in Fig. 3, Sketches (1), (m) and (n), the fusion zone and the parent metal beneath the attachment surface shall be ultrasonically examined in accordance with Case 1275N after welding to insure freedom from lack of fusion and laminar defects.

(e) The inner corners of finished openings in which the nozzle necks do not extend beyond the inner surface of the part penetrated, shall be rounded to a radius of 1/4 the required thickness of the

part penetrated, but such radius need not exceed $^3/_4$ in.

The corners of the end of each nozzle neck extending less than the square root of $d \times t_n$ beyond the inner surface of the part penetrated shall be rounded to a radius of $^1/_2$ the thickness of the nozzle neck, but such radius need not exceed $^3/_4$ in.

(f) Fillet welds used in the attachment of nozzles shall be used only to provide a transition between the parts being joined or to provide a seal. The throat dimension t_c of fillet welds, when used, shall be at least the smaller of $^1/_4$ in. or $0.7\ t_n$ and shall be finished by grinding to provide a smooth surface and having a transition radius at its intersection with either part being joined of not less than $^1/_4$ of the thickness of the thinner of the parts being joined.

(g) Attachment of Connections Using Partial Penetration Welds—

(1) Partial Penetration Attachments—Partial penetration attachments used to connect nozzle necks as permitted in (a) shall be groove welds having a minimum depth equal to $1^1/_4$ times the nominal thickness of the neck. These welds shall be inspected by progressive magnetic particle or penetrant methods. Acceptable types are shown in Fig. 4.

(2) The corner radius requirements of 6(e) shall be met.

(7) The Code rules are intended to provide minimum safety requirements for new construction, and not to cover deterioration which may occur in service as a result of corrosion, erosion, radiation effects, instability of the material, or operating conditions such as transient thermal stress or mechanical shock and vibratory loading; nevertheless particular consideration shall be given to these effects with a view to obtaining the desired life of the vessel.

(8) In view of these severe service requirements, particular consideration shall also be given to materials, construction, and inspection, including supplementary methods of non-destructive testing, so that soundness and good practice will result. Due regard shall be given to such items as smoothness of welds and to location and detail of structural attachments.

(9) When the surface exposed to the fluid under pressure is required to be clad with a material having better corrosion resistance than the base metal, the rules of Part UCL of Section VIII governing application of cladding shall apply except as modified below and the applicable design formulas from Section I or Section VIII may be used with the following supplementary rule:

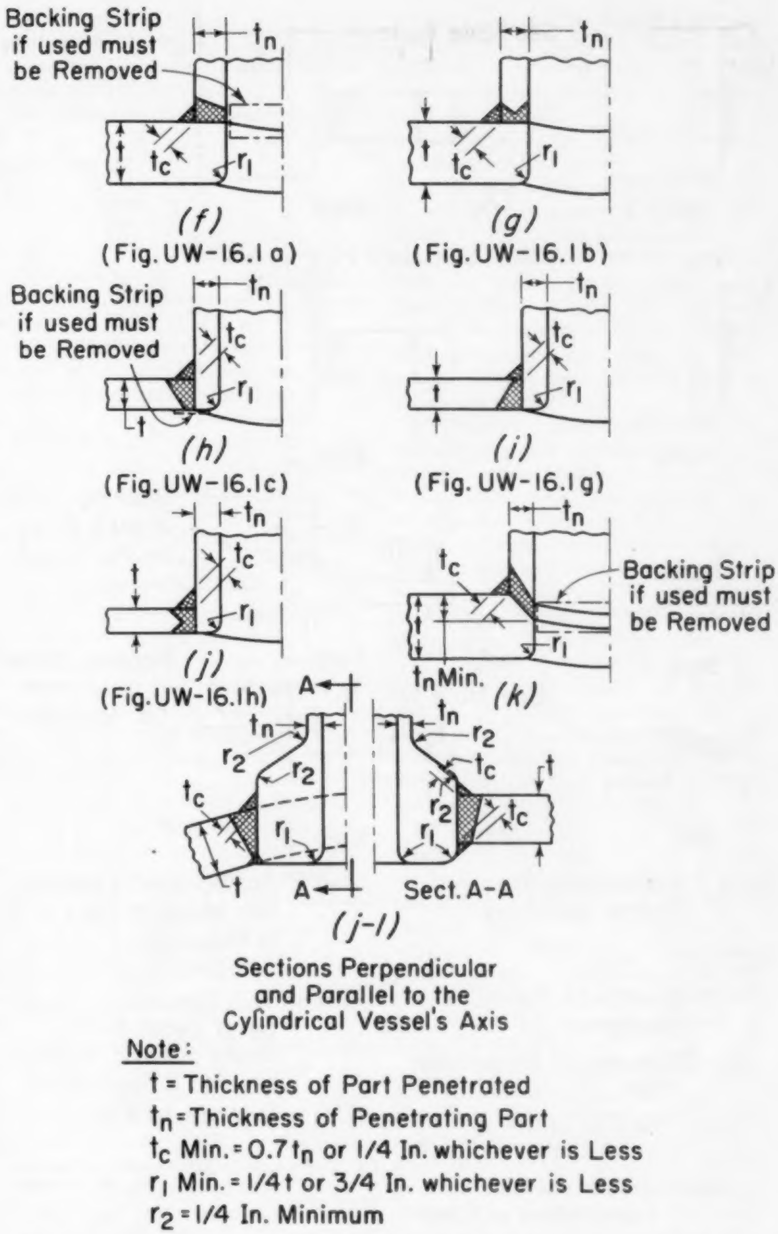
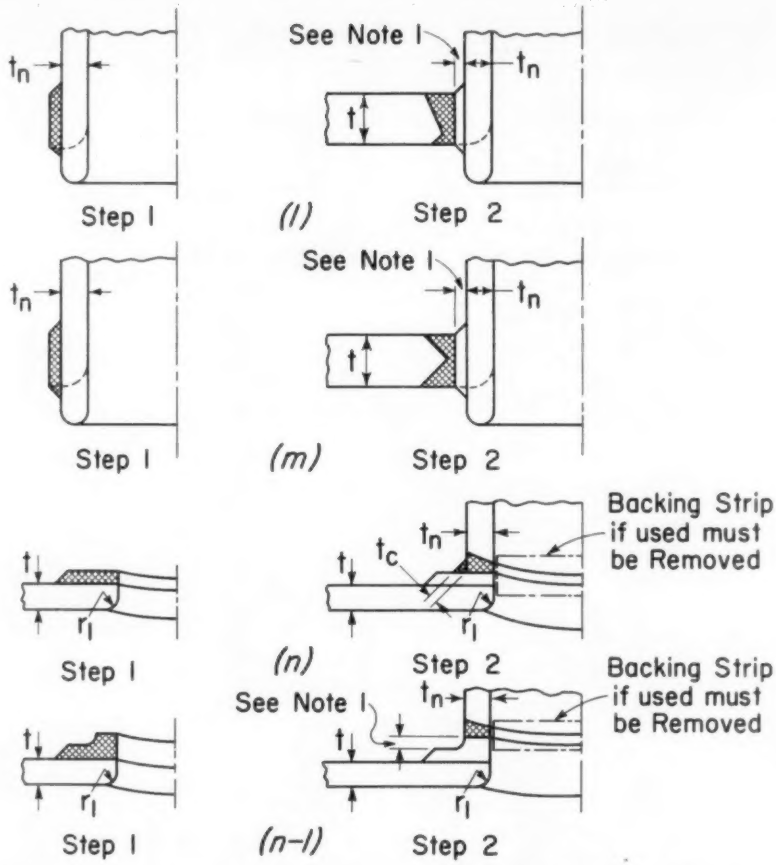


Fig. 2 Acceptable full penetration welded nozzle attachments radiographable with difficulty and generally requiring special techniques including multiple exposures to take care of thickness variations

(a) The specified nominal thickness of the cladding shall not be included as a part of the required wall thickness. In applying the design formula the diameter shall be taken as the inside diameter plus twice the specified nominal thickness of the cladding.

(10) When the parallelism or perpendicularity requirements of nozzle (such as are used in control rods, etc.) must be maintained for operational or functional reasons to tolerances closer than those which can be obtained by means involving the stress relief of the composite structure with its associated distortion of the nozzle parts, thermal stress relief of the complete component fabricated of welded carbon or low alloy steel is not required provided:

(a) The opening is completely reinforced with the reinforcement located in the vessel shell or head.



Step 1: Examination Required Before Assembly

Step 2: Radiographic Examination Made to Fig 1 or 2 is Required of the Attachment Used

Note:

t = Thickness of Part Penetrated

t_n = Thickness of Penetrating Part

t_c Min. = 0.7 t_n or 1/4 In. whichever is Less

r_1 Min. = 1/4 t or 3/4 In. whichever is Less

r_2 = 1/4 In. Minimum

Note 1: This Dimension Shall be at Least 3/4 In. When Step 2 Radiographic Examination is Made to Fig 1

Fig. 3 Acceptable full penetration welded nozzle attachments requiring intermediate examination

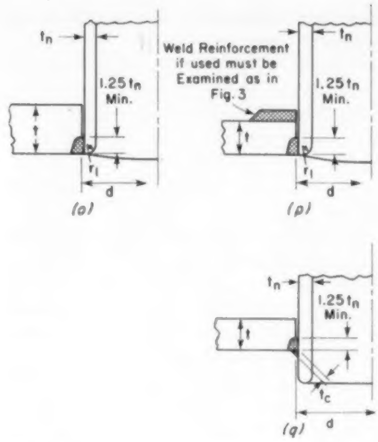
(b) Mechanical means such as some slight interference fit of the two mating parts is employed to insure tight contact and relieve external bending stresses on the weld joints.

(c) The nozzle weldment is performed by a proven procedure, complying with the requirements of Section IX of the Code so that the heat affected zones of all parts is made and stress relieved prior to final welding with weld metal that will satisfy the requirements of Section IX without the necessity of a final stress relief.

Case 1274N-4
(*Special Ruling*)
Special Material Requirements

Revise the Inquiry to read:

Inquiry: What requirements for materials not listed as materials adopted for Code construction and what special construction and special requirements for Code adopted materials may be used in nuclear pressure vessels conforming to the requirements of Section I or Section VIII of the Code as supplemented by Case 1273N.



Note:
t = thickness of part penetrated
t_n = thickness of penetrating part
t_c min. = 0.7t_n or 1/4 in. whichever is less
r_1 min. = 1/4t_n or 1/4 in. whichever is less
Weld groove design for oblique nozzles of this type requires special consideration to achieve the 1.25 t_n minimum depth of weld and adequate access for welding and inspection.
With due regard to the requirements in Par. (4)(b) and in the last sentence in Par. (6)(a)(2), the welds shown in the sketches may be on either the inside or the outside.

Fig. 4 Partial penetration welded nozzle attachments acceptable when independent of reinforcement requirements

Add a new paragraph to the Reply as follows:

(5) The rules of Section VIII, Part UHA, pertaining to Types 304L and 316L, low carbon stainless steel, may be used for nuclear vessels to be built and stamped under the rules of Section I.

Case 1290

Interpretation of Par. UG-29, Stiffening Ring Design

Inquiry: Par. UG-29 in Section VIII of the Code contains rules for the design of stiffening rings for cylindrical shells under external pressure. Is it permissible to use the moment of inertia of a combined section made up of the added stiffening ring and a portion of the shell plate when calculating the required moment of inertia?

Reply: It is the opinion of the Committee that, as an alternate to the method given in Par. UG-29, a portion of the shell plate may be considered in combination with the added stiffening ring in determining the required moment of inertia, provided that the calculated moment of inertia of the combined stiffener and shell section shall be not less than 1.3 I_s, as defined in Par. UG-29. The width of the shell plate to be considered effective for stiffening shall be

not more than $1.10\sqrt{D_o t}$, where D_o and t shall be as defined in Par. UG-28(b). This width shall be considered as being centered about the center of gravity of the section of the added stiffening ring. If the stiffeners should be so located that the maximum permissible effective shell sections overlap, the effective shell section for each stiffener shall be shortened by one-half of the overlap. All other provisions of Pars. UG-29 and UG-30 shall apply.

Case 1291

(*Special Ruling*)

Use of Cast Aluminum Alloys

Inquiry: May aluminum casting alloy SG70A meeting the requirements of ASTM Specification B26-59T (Aluminum Association Designation 356) be used in unfired pressure vessels which are to be constructed and stamped in accordance with the rules of Section VIII of the ASME Boiler and Pressure Vessel Code?

Reply: It is the opinion of the Committee that aluminum casting alloy SG70A of ASTM Specification B26-59T may be used for unfired pressure vessels constructed and stamped in accordance with Section VIII under the following conditions:

(1) The following maximum allowable stress values multiplied by the casting factors specified in Par. UG-24 shall be used with the design rules when reference is made to Table UNF-23:

For Metal Temps. Not Exceeding Deg F

Condition	100	150	200	250	300	350	400
—T6	7500	7400	6900	5700	..	..	..
—T71	6250	6000	5750	5500	4950	3750	2600

(2) This alloy shall not be welded.

Case 1292

(*Special Ruling*)

Resistance Welding for Other Than Butt Joints

Inquiry: Is it permissible to construct unfired pressure vessels with the following limitations under such requirements of Section VIII of the ASME Boiler and Pressure Vessel Code as are applicable, using resistance spot welding and resistance seam welding?

(1) Construction is limited to embossed or dimpled assemblies,[1] each design of which requires proof testing for determination of allowable working pressure.

(2) Materials used in the resistance welded parts of such vessels are

(a) Carbon Steel

Specifications SA-285 and SA-414 with the further limitation that the carbon content is 0.15% maximum.

(b) Chromium-Nickel-Austenitic Steels

SA-240 Type 302
304
304L
316
316L

(3) Operation at an internal pressure of no more than 250 psi and an internal volume of no more than 5 cu ft.

(4) Used for the containment of air, water, steam, ammonia, or the chlorinated or fluorinated hydrocarbon refrigerants.

Reply: It is the opinion of the Committee that resistance spot welding and resistance seam welding may be used in the construction of unfired pressure vessels, under the limitations of the inquiry, provided the following additional requirements are complied with:

(1) The allowable working pressure for resistance welded embossed or dimpled assemblies shall be established in accordance with the requirements of Section VIII, Par. UG-101. Allowable working pressure of components which can be calculated shall be done in accordance with the Code.

(2) In lieu of the present Procedure Qualification and Performance Qualification requirements of Section IX, the following requirements shall be met for resistance spot welded and resistance seam welded pressure vessels:

(a) Proof Test A pressure proof test to destruction shall be conducted on a finished vessel, as specified in Par. UG-101(m) of Section VIII.

(b) Workmanship Samples Three single spot welded specimens and/or one seam welded specimen, as shown in Figs. 1 and 2, shall be made immediately before and after the welding of the proof test vessel. These test specimens shall be representative of the manufacturing practice employed in the fabrication of the proof test vessel. When a difference in the amount of magnetic material in the throat of the machine or the part geometry preclude the welding of satisfactory test specimens at the same machine settings as those used for the proof test vessel, sufficient material shall be p'aced in the throat of the welding machine to compensate for the difference in size of the proof test panel and the small test specimens.

The spot welded specimens shall be subjected to tensile loading for ultimate strength and visually inspected for nugget size, electrode indentation and evidence of defects. The seam weld specimens shall be similarly tested for ultimate strength, and prepared for macrographic examination to reveal nugget size, spacing, penetration, soundness and surface condition.

In addition, a typical spot weld sample and seam welded sample shall be cut from the proof test vessel after failure. A portion of each sample shall be sectioned for macro-etch examination.

All pertinent information obtained from the foregoing tests shall be recorded. These samples and data constitute Workmanship Samples which shall be available for comparison with quality control specimens that may be made during production.

(c) Machine Settings and Controls The resistance welding machine settings and process control parameters used in the making of the proof test vessel and the Workmanship Samples shall be recorded. Except for minor variations and adjustments as may be permitted at the discretion of the inspector, the applicable settings shall be used in the fabrication of all vessels in a given production run.

(d) Pressure Tests and Inspection All production vessels shall be pressure tested to a pressure not less than 1.5 times the allowable working pressure. These tests and inspection during fabrication shall be in accordance with Par. UG-97 and Par. UG-99 of Section VIII.

(e) Records In accordance with the requirements of paragraph (2)(b), records shall be kept of all data obtained from test of the proof test vessel, the Workmanship Samples, the welding machine settings, the welding procedure, and process control parameters. Records shall be kept of all preheat, post-heat, and heat-treatment procedures, and of inspection procedures.

(3) If spot and seam welding machines other than those used for the initial proof test vessel and Workmanship Samples are to be used in production, each additional machine and welding procedure shall be qualified in full accordance with Par. (2) above. The performance of the additional proof test vessels shall substantiate the allowable working pressure previously established for the specific pressure vessel design.

(4) The resistance welding of carbon steel to chromium-nickel austenitic stainless steel is not permitted by this case.

(5) Lap joints only, between two thicknesses of metal sheet, shall be resistance welded. The spot and seam welding of more than two thicknesses is excluded. The use of projection welding (including resistance stud welding) is excluded.

(6) The range of thickness of sheet materials which may be resistance spot

[1] Embossed or dimpled assemblies consist of either two embossed plates welded together, or two dimpled plates welded together, or an embossed or dimpled plate welded to a flat plate.

or seam welded under this case shall be

0.045 in. (approx. 18 gage) minimum
0.188 in. (approx. 7 gage) maximum

(7) If arc-welding, gas-welding, or brazing are used for the attachment of nozzles, tubes and fittings, or for the closing of peripheral seams, the qualification of welding procedure and welding performance shall be conducted in accordance with the requirements of Section IX. Filler metals, if used, shall conform to the requirements of Section IX.

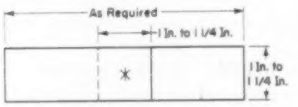


Fig. 1 Single-spot-weld tension specimen

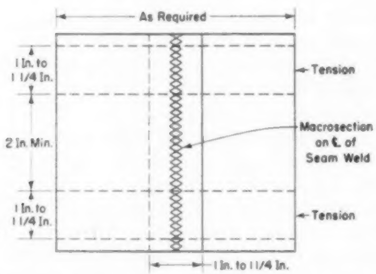


Fig. 2 Seam-weld specimen for tension and macrosection

Case 1294

Use of Specification SA-193 as Forgings

Inquiry: May the material covered in Specification SA-193 be used for yokes which function in lieu of conventional bolting to provide quick-opening closures for pressure vessels?

Reply: It is the opinion of the Committee that the materials covered in Specification SA-193 may be used for yokes as described in the Inquiry with the following additional requirements:

1 They shall not be welded.

2 In addition to the testing required by Specification SA-370, this material shall be tested and meet the requirements of Par. UG-84 at the lowest temperature specified for service.

3 Allowable stresses shall be the same as those given for the comparable grade under Specification SA-193.

4 The requirements of Par. UG-35 shall be met.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semi-annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1959

PARS. A-22 through A-32

Delete present paragraphs and replace with revised paragraphs: (Revised Paragraphs available from the Secretary of the ASME Boiler and Pressure Vessel Committee, 29 West 39th Street, New York 18, N. Y.)

Material Specifications, 1959

The Boiler and Pressure Vessel Committee approved adding to Section II the following revisions to Specifications:

Tube and Pipe Specifications

SA-53-60T	SA-226-60T
SA-83-60T	SA-249-60T
SA-106-60T	SA-250-60T
SA-135-60T	SA-268-60T
SA-178-60T	SA-312-60T
SA-179-60T	SA-333-60T
SA-192-60T	SA-334-60T
SA-199-60T	SA-335-60T
SA-209-60T	SA-369-60T
SA-210-60T	SA-376-60T
SA-213-60T	SA-423-60T
SA-214-60T	

Plate Specifications

SA-6-60T

Forgings and Bolting

SA-29-60T
SA-266-60T
SA-306-60T

Casting Specifications

SA-216-60T	SA-352-60T
SA-217-60T	SA-193-60T

Spec. SB-149 Delete Alloy 11B and add Alloy 11A.

The Boiler and Pressure Vessel Committee approved adding to Section II, the following new specification:

SB-359-60T Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes with Integral Fins.

Unfired Pressure Vessels, 1959

PAR. UG-101

Delete present paragraph and replace with revised paragraph: (Revised Paragraph available from the Secretary of the ASME Boiler and Pressure Vessel Committee, 29 W 39th Street, New York 18, New York.)

PAR. UG-102

After the words "all gages" add: used in proof testing.

Table UNF-23 Copper and Copper Alloys

Add the Material and Stress values shown.

Table UHA-23

Add the stress values shown.

Welding Qualifications, 1959

Table Q-11.1

Under P-Number 1 add SA-433 Leaded Steel Plates.

Table UNF-23 Copper and Copper Alloys

Matl and Spec Number	Condition	Size in	Specified Minimum Tensile Strength, psi	Specified Minimum Yield Strength, psi	For Metal Temperatures Not Exceeding Deg F 100	150	200	250	300
CASTING MATERIAL									
SB-149 Alloy 11A	...	...	30,000	17,000	6000	6000	5800	5500	5000

Table UHA-23

Matl and Spec No	Grade	Type	Nominal Comp	Spec Min Tensile, psi	Notes	For Metal Temperatures Not Exceeding Deg F −20 to 100	200	300	400	500	600	650	700	750	800	850	900
BOLTING																	
SA-193	B6	410	13Cr	...	(5)	20000	19300	18700	18300	17850	17000	16500	15750	14900	13800	12500	11000

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Engineering Professionalism in Industry

▶One out of four engineers in industry believes that engineers are thought of as second-class professionals, but no industrial managers agree with this opinion.

▶Sixty-one per cent of the engineers employed in industry think there is considerable malutilization of engineers, but only 30 per cent of industrial managers agree.

▶More than half the engineers in industry think that higher pay would advance the engineering profession, but only 20 per cent of industrial managers agree.

THESE are some of the findings reported in a survey entitled "Engineering Professionalism in Industry" made under the sponsorship of the Professional Engineers Conference Board for Industry, in cooperation with the National Society of Professional Engineers.

The survey, the sixth in a series made for the Conference Board, is now available in booklet form. Opinion Research Corporation made the survey on the basis of extensive "depth" interviews with engineers and managers.

Primary objective of the study was to find out what engineers and engineering managers mean by professionalism, and how they think it can best be advanced. The engineers and managers interviewed all work for large companies that employ many engineers and are located in various parts of the country from the East to the West Coast. Six major industries are represented in the sample: Chemicals, electronics, petroleum, rubber, aircraft manufacturing and electrical instruments, and machinery.

Engineers Making Valuable Contribution. The interviews brought out that 90 per cent of the managers questioned stated that they regarded engineers among the employees making the most valuable contribution to the company. Less than half of the engineers felt that they were so regarded by management.

Creative Atmosphere. One fourth of the engineers stated that management tries to provide a creative atmosphere, but nearly half of the managers claimed that management tries to provide such an atmosphere. Sixty-eight per cent of the managers indicated they believed management shows genuine respect for engineers; however, only 36 per cent of the engineers agreed with this. "Companies should not only re-examine whether they are doing enough, but also whether they are communicating their efforts to engineers. If companies are doing all the things they say they are, many of these programs and policies are not now getting through to engineers."

Professional Attitudes. The survey also found a considerable difference in professional attitudes between engineers in companies which would score high on efforts to encourage and develop high standards of engineering professionalism and engineers in those companies which would not score so high in such an evaluation.

Forty-four per cent of the engineers in the afore-mentioned "high scoring" companies stated that management really believes in the professional status of engineers, while only seven per cent of the engineers in the second type of company agreed with this.

Fifty-three per cent of the engineers in the second type of company said that engineers are "sort of a commodity—let go quickly if business is poor," but only 17 per cent of the engineers surveyed in the high scoring companies held this view.

Malutilization of Engineers. Forty-nine per cent of the engineers in the "high scoring" companies admitted to considerable malutilization of engineers, but 82 per cent of the engineers in the second type of company said there was considerable malutilization.

Questions asked of engineers and managers indicated the reservations that both groups have as to how well company policies on professionalism are carried out by supervisors. Only one engineer in six, and one manager in five, feels that these policies are carried out "very effectively" at the direct level of supervision. Outright criticisms regarding this are much more pronounced among engineers and managers in the second type of companies than among those in the high scoring companies.

Unionization. The survey found widespread agreement in the high scoring type of companies that unions are incompatible with engineering professionalism. In the second type of companies, interviewers found more sentiment against than for engineering unions, but nowhere near the sentiment against such unions as was found in the "high scoring" companies.

In general, managers agree with engineers on the basic ingredients of professionalism. However, managers put primary emphasis on engineers' technical qualifications. While engineers, consistent with their technical orientation, agree that these elements are essential, they also consider many other things important, including a truly professional atmosphere and recognition of professional status by the company.

The survey concludes that much remains to be done to bring professionalism to a higher level in companies. Even in the high scoring companies, only 41 per cent of engineers feel that their professional status is recognized to a high degree. The problem is more acute in the second type of companies, where only 15 per cent of engineers feel this way.

Salaries. Engineers and managers agreed that salary progression should reflect engineers' contributions. Three fourths of the managers stated that their companies follow such a policy, and less than a third of the engineers said their companies follow such a policy. Sixty-five per cent of the managers said their companies let engineers try for high positions anywhere in the organization, but only 29 per cent of the engineers agreed with this.

The published survey reports may be obtained from the National Society, 2029 "K" Street, N. W., Washington 6, D. C., at $4 a copy for nonmembers and $2 for members.

President Eisenhower, **right**, receives Hoover Medal from Walker L. Cisler, past-president ASME

President Eisenhower Receives Hoover Medal

For the second time, a President of the United States received the Hoover Medal, sponsored by four of the nation's leading engineering societies. Dwight D. Eisenhower was presented with the award at a dinner in Washington, D. C., on January 10. Herbert Hoover, after whom the medal is named, was its first recipient in 1930.

Walker L. Cisler, president of the Detroit Edison Company, past-president of The American Society of Mechanical Engineers, and chairman of the Hoover Medal Board of Award, made the presentation.

President Eisenhower's appearance at the dinner, attended by some 400 guest, was one of his last public appearances as President.

President Eisenhower's citation from the engineering group reads: "History records the leadership in world peace which Dwight David Eisenhower has given to all people in preparing and directing undertakings of monumental engineering dimensions in military and civilian operations of great magnitude and far reaching significance. As organizer, leader, and our President, he has throughout his illustrious career given proof of the importance of the individual by the impact of his actions in building a better world for people everywhere."

Sponsors of the Award are the American Society of Civil Engineers, the American Institute of Mining, Metallurgical, and Petroleum Engineers, The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

S. L. A. Marshall, Brigadier General, USA, ret., was speaker at the dinner.

Steel-Casting Industry Plans Year-Long Centennial

The steel-casting industry launched its year-long centennial observance with a Newcomen Address delivered in Philadelphia, Pa., January 19, by W. H. Moriarty, president of the Steel Founders' Society of America, the industry's national association.

Mr. Moriarty's address at the Annual Benjamin Franklin Birthday Dinner of the Newcomen Society in North America traced the growth of the steel-casting industry from its birth in Buffalo, N. Y., in 1861 to the present.

First Steel Castings. The first steel castings made in the United States were for railroad use and were made by the Buffalo Malleable Iron Works—now the Pratt & Letchworth Division of the Dayton Malleable Iron Company, Mr. Moriarty told his audience of nearly 500 industrialists.

He went on to say that casting steel to final shape was unknown until 1845 when a Swiss metallurgist, Johann Conrad Fisher, exhibited in Europe some small steel castings and applied for a British patent to cover a "new way to make horseshoes." Six years after the Buffalo company started the manufacture of steel castings in the U. S., the William Butcher Steel Works was founded in Philadelphia and was the first company to produce steel castings as a commercial enterprise. The first products were crossing frogs and car wheels.

The first company organized exclusively for the manufacture of steel castings was the Pittsburgh Steel Casting Company in Pittsburgh. The founder of the company, William Hainsworth, held more than 40 patents—many in the foundry field—and for 12 years his company produced 98 per cent of all the steel castings made in the United States.

Tonnage Figures. Mr. Moriarty said that tonnage figures for the first few years were not recorded, but the entire industry produced less than 1700 tons in 1883. By 1900, the industry was producing 177,156 tons of steel castings. Today, the steel casting industry has an annual capacity of $2^1/_2$ million tons and employs more than 50,000 persons.

Steel castings are used in practically every field requiring strong parts of intricate design. They range in weight from less than an ounce to 254 tons.

SFS Annual Meeting. The annual meeting of the Steel Founders' Society, which will be held March 11–14 at the Drake Hotel in Chicago, will be devoted to the "next 100 years of progress."

Centennial Product-Development Contest. Currently, the Society is conducting a Centennial Product-Development Contest to obtain the best examples of new and redesigned products made as steel castings. It is open to students and employees in customer industries, and $10,000 in prizes will be awarded for the best entries. The contest closes June 1, 1961.

"Ideas, Inertia, and Achievement"—ASME Book—Result of Many Expert Opinions

Western science and technology vital enough to offset government-dominated system is revealed in reports

The current vitality of the Western world's science and technology is sufficient to offset isolated advantages of a government-dominated system according to the report issued recently by The American Society of Mechanical Engineers.

This report, which presents the views and experiences of chief executives, scientists, and engineers of 88 leading corporations and research institutions in the United States and Western Europe, also offers a set of suggestions to overcome the apparent time lag between original scientific discovery and engineering application in a free-enterprise system.

The 100,000-word volume entitled

"Ideas, Inertia, and Achievement" was introduced by Walker L. Cisler, past-president ASME, and chairman of the board of the Detroit Edison Company, as a "significant and useful contribution to the efforts of America and the Free World to maintain free enterprise's traditional lead in providing an economic climate in which free men can live better and in greater security than under any other system." This volume, made up of individual reports from more than 100 specialists, was assembled and prepared by Fenton B. Turck, who was asked to undertake the study by ASME. Mr. Turck is president of F. B. Turck & Company, a consulting engineering firm in New York City.

Principal strengths of the Soviet system for speeding practical application of scientific discovery are found to be in (*a*) centralized direction of all national research effort, and (*b*) government-sponsored dissemination of all existing scientific and technical information without regard to competitive conditions or sources.

The American executives, however, find these factors more than balanced by the wide-ranging initiative employed by management in a free-enterprise system, by the additional freedoms enjoyed by both engineers and scientists, and by the much greater experimentation encouraged under private industry.

"Analysis of the Soviet system," according to Mr. Turck, "shows five grievous Soviet errors. Russian management fails to recognize that one mind cannot possibly preguess the outcome of scientific venture. The Soviet tries to combine propaganda with progress. They have a dire shortage of individual imagination. Their scientists have to work under extreme political pressure."

The ASME report does not attempt to gloss over "unhealthy manifestations" in private enterprise. "There was general agreement that the strength of a free enterprise economy stems importantly from a flexible and efficient flow of scientific and technological information. When this flow is impeded, tragic waste results, and our industry is left for too long operating with inferior techniques that are worthy neither of our scientists nor of our engineers."

It points out that "engineers and technicians, often accustomed to doing a job in a particular way, need to be more alert to the use of improved products and techniques, and less resistant to change." The theme stressed by most respondents is that "The best opportunity for reducing this time lag in individual companies and industries depends not entirely upon the scientists and engineers themselves, in spite of all they obviously can contribute, but upon management's ability to ascertain the significance and importance of original scientific findings —and its willingness to take proper and prompt steps to do something about them."

Two problems were highlighted in the study:

1 The basic scientist does not speak the same language as does the applications engineer. The two are not motivated by the same purpose. Not only is there need for internal communications within a corporate entity that will insure best possible understanding of the link between discovery and use, but also there must be an awareness of the findings of all other researchers throughout the world in the area of investigation.

2 Adequate or inadequate as the communications system may be, there remains the decision-making function of management as to how and where to spend available capital and manpower, and most importantly, upon how sound a judgment they make as to which of many possible alternate original scientific projects are given first priority.

Copies of the book may be obtained at $5 each from the Order Department, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N.Y.

MEETINGS OF OTHER SOCIETIES

• IN THE UNITED STATES

February 20–23

Industrial Ventilation Conference, sponsored by Michigan State University College of Engineering and Michigan Department of Health, Kellogg Center, E. Lansing, Mich.

February 20–23

TAPPI, 46th annual meeting, Commodore Hotel, New York, N. Y.

February 26–March 1

AIChE, national meeting, Roosevelt Hotel, New Orleans, La.

February 26–March 2

AIME, annual meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

February 27–March 1

Association of Iron and Steel Engineers meeting, Hotel Statler, Los Angeles, Calif.

March 7–9

American Railway Engineering Association, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

March 8–10

ISA, 11th annual conference on instrumentation for the iron and steel industry, Roosevelt Hotel, Pittsburgh, Pa.

March 9–10

Institute of the Aeronautical Sciences, flight propulsion meeting, Carter Hotel, Cleveland, Ohio.

March 13–17

National Association of Corrosion Engineers, annual conference, Statler Hotel, Buffalo, N. Y.

March 14–16

SAE, national automobile meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

• IN EUROPE

April 17–19

International Meeting on Fluid Sealing, sponsored by the British Hydromechanics Research Association, Grosvenor Hall, Ashford, Kent, England.

May 2–9

Sixth international packaging exhibition, organized by N. V. 't Raedthuys, to be held in the R. A. I. exhibition halls, Amsterdam, The Netherlands.

May 15–19

The Institute of Fuel, conference on waste heat recovery from industrial furnaces, Bournemouth, England.

July 30–August 6

International Symposium on the Durability of Concrete, prepared by the Czechoslovak Academy of Sciences, Institute of Theoretical and Applied Mechanics, within the framework of The Permanent Committee of Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions (RILEM); to be held in Prague.

• IN CANADA

October 19–November 7

The Iron and Steel Institute, special meeting in the U. S. and Canada.

• IN MEXICO

March 2–12

Third Inter-American Management Conference, on Scientific Management and its Responsibility for Bettering the Standard of Living of the Americas, organized by the Confederación Patronal de la Republica Mexicana, the Mexican affiliate of PACCIOS, Mexico City.

(*For ASME Coming Events, see page 118.*)

United Engineering Center

By Jan. 11, 1961, the new United Engineering Center looked like this. Glass and spendrelite enclosed 15 floors. Stainless-steel mullions extended to the 18th story. While construction progresses rapidly, one big question looms ahead: How do we pay for the Center? At the 1960 ASME Business Meeting, Willis Thompson, President of UET, gave this answer: "The depreciation fund which UET has is $1,530,000. Sale of the 39th Street building was $1,500,000. Subscriptions in the industrial campaign amounted to $4,956,000, slightly short of $5 million. We hoped to have raised $5,200,000 and we may. Subscriptions and member gifts campaign totaled $3,335,000. Unfilled quotas in member gifts campaign approximately $500,000, of which practically $225,000 is from the American Society of Heating, Ventilating, and Air-Conditioning Engineers. They hope, however, to do the best they can. That leaves us insufficient funds of $479,000; that is, providing the subscriptions in member gifts and unfilled quotas will all come through. However, this is the first time since coming into the Society, in 1919, that I can remember where ASME dragged its feet. I am not discouraged at all about ASME. I think it is just a question of getting people out to contact the members so that they realize that we are going to be short about a half million dollars even with their subscription limitations. Because of that, I hope that when you reach your quota of $800,000 that you won't stop there, but will continue on."

The Second Mile—ASME Member Gifts Campaign

Since September 30: $27,000 in, and now $62,000 to go.

The five Sections with the most to go accounted for $6300, and three Sections well over the top added $8400 to this gain. It is encouraging to note the activity in those cities at the bottom of the totem pole. It is heartening to realize the genuine enthusiasm for this project that puts a Section over the top never lets up, so long as the Society goal is yet to be achieved. That spirit is what makes us a Society of professional men, that ability to travel the second mile.

This thought brings us to the realization that many, with the well-being of ASME at heart, must dig ever deeper into their resources and pledge again between now and June. It has been demonstrated many times in this campaign that loyal members are willing to travel this second mile, that ASME may meet its obligation.

All it takes is somebody in the Section with enough determination to ask.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

ASME Design Engineering Conference and Concurrent Design Engineering Show in Detroit, May 22–25, for First Time

Cobo Hall, with new, excellent exhibit and conference facilities, and an up-to-the-minute conference and exhibition should, attract largest audience of U. S. and Canadian engineers in design engineering field

THE Design Engineering Show and Conference, taking advantage of the opening of Cobo Hall, will move to Detroit, Mich., for the first time in 1961. The Machine Design Division of The American Society of Mechanical Engineers will sponsor the conference for the sixth consecutive year. The show is produced by Clapp & Poliak, Inc., New York exposition management firm. The exposition and conference will take place May 22 through 25.

The Show. The show will be the largest in its history and will occupy all available space in the huge hall. More than 400 companies will exhibit.

Newly opened Cobo Hall, with its unusual construction and advanced design, will permit a spectacular presentation of hundreds of exhibits in a five-acre area virtually free of columns or pillars. An unobscured view of the exhibit area will thus greet the eyes of visitors. Lighting is of the most modern type with 150 candle-power delivered at reading height.

Conveniences for visitors also include a large restaurant, a coffee shop, and a number of snack bars on the premises. Rooms for conference sessions, similarly, are on the same premises.

The hall is only a five to ten-minute walk from major hotels. It is in the heart of the downtown area and overlooks the Detroit River, directly across from Windsor, Ont., Canada. The number of Canadian visitors is expected to reach an all-time high.

Show hours will be from noon to 5:30 p.m. each day except Tuesday when it will remain open until 10:00 p.m. to permit those who cannot attend during business hours to see the show.

The Conference. The area of discussion in the conference will be expanded greatly. A number of extra sessions are being planned to permit more intensive consideration of several aspects of design

Detroit skyline, Cobo Hall in foreground. Cobo Hall and Convention Arena offers more than 400,000 (9 acres) sq ft of almost totally unobstructed space to house shows, expositions, and exhibits. Cobo Hall is flexible: 100,000 sq ft in one unit, 300,000 in another, can be combined to house one major event or partitioned to hold as many as four events simultaneously. The main auditorium can hold up to 14,000 and 33 smaller rooms will hold meetings ranging in attendance from 80 to 3000. A cafeteria can seat 1500. Parking for nearly 2000 cars is provided within the building and on the roof, with additional thousands of parking spaces provided in the adjacent Civic Center. Cobo Hall and the Convention Arena rounds out Detroit's great new Civic Center on the downtown riverfront. From May 22 through 25, ASME Design Engineering Conference and the Design Engineering Show will be held here.

engineering. In order to eliminate conflict with the exposition, the conference sessions will be held from 9:00 a.m. until noon.

The conference program is still in the completion stage; however, as we go to press, we can report that 20 or more papers will be presented in ten sessions. The opening day of the conference will be devoted to a panel discussion of methods used to establish the performance, maintenance, and appearance of the new machine or model.

Some of the papers deal with designing for production, materials standardization to reduce costs, special requirements of hydraulic systems for servo control of machinery, standardization of product design, and drawing techniques for use on numerically controlled production equipment, and so on.

Interest in the use of glass is manifested by two papers tentatively titled, "Glass, Ceramics, and Glass-Ceramics" and "Designing Parts to Be Made of Glass, Ceramics, or Glass-Ceramics." Other papers will cover the uses of steel, motors, drives for tape-controlled tools, adhesives, design of plastic parts, an aluminum die-cast engine, and new developments in types of fasteners.

Both show and conference are devoted to the research and development aspects of new products of all types. Materials and component parts for virtually every kind of manufactured product, from everyday household items to space ships, will be shown.

ASME-AIEE Railroad Conference, San Francisco, Calif., April 20-21, 1961

San Francisco will be the host city to the 1961 ASME-AIEE Railroad Conference scheduled for April 20 and 21. The Sir Francis Drake Hotel will serve as conference headquarters.

The technical program for the conference will highlight topics of current local and national interest such as rapid-transit progress and diesel locomotive developments. Social events featuring prominent speakers will be an important part of the total conference program.

The conference will be sponsored by the Railroad Division of The ASME and the Land Transportation Committee of the AIEE, with the co-operation of the San Francisco sections of each society.

ASME Boiler and Pressure Vessel Committee to Meet in Charlotte, N. C., March 12–17

The Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers holds six meetings a year, one of which is held outside of New York City. The 1961 meeting will be held jointly with The National Board of Boiler and Pressure Vessel Inspectors at the Barringer Hotel, Charlotte, N. C., March 12 to March 17, inclusive.

Meetings will be held of the various subcommittees covering, in part, power and heating boilers as well as unfired pressure vessels. The National Board of Boiler and Pressure Inspectors also will hold sessions at this meeting. There will be addresses by the various State and City representatives.

The all-day session of the Boiler and Pressure Vessel Committee is planned for Friday. Meetings of the various subcommittees as well as the Boiler and Pressure Vessel Committee are open to the public.

Representatives from the Boiler and Pressure Vessel Committee and The National Board of Boiler and Pressure Vessel Inspectors as well as Region IV comprise the Planning Committee.

ASME COMING EVENTS

March 5–9, 1961
ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D.C.

March 12–15, 1961
ASME Aviation Conference, Statler Hilton Hotel, Los Angeles, Calif.

March 12-17, 1961
ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting, jointly with The National Board of Boiler and Pressure Vessel Inspectors, Barringer Hotel, Charlotte, N. C.

March 16–17, 1961
ASME Textile Engineering Conference, Clemson College, Clemson, S. C.

April 6–7, 1961
ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

April 9–13, 1961
ASME Oil and Gas Power Conference and Exhibit, Jung Hotel, New Orleans, La.

April 10–11, 1961
ASME Maintenance and Plant Engineering Conference, Bancroft Hotel, Worcester, Mass.

April 20–21, 1961
ASME-AIEE Railroad Conference, Sir Francis Drake Hotel, San Francisco, Calif.

April 23–26, 1961
ASME Metals Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

May 7–10, 1961
ASME-EIC Hydraulic Conference, Queen Elizabeth Hotel, Montreal, Que., Canada

May 8–9, 1961
Lubrication Symposium, Deauville Hotel, Miami Beach, Fla.

May 10–12, 1961
ASME Production Engineering Conference, Royal York Hotel, Toronto, Ont., Canada

May 22–25, 1961
ASME Design Engineering Conference and Exhibit, Cobo Hall, Detroit, Mich.

June 11–14, 1961
ASME Summer Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

June 14–16, 1961
ASME Applied Mechanics Conference, Illinois Institute of Technology, Chicago, Ill.

August 28–30, 1961
ASME West Coast Conference of Applied Mechanics, University of Washington, Seattle, Wash.

August 28–September 1, 1961
Second International Heat Transfer Conference, University of Colorado, Boulder, Colo.

September 14–15, 1961
ASME-AIEE Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

September 24–27, 1961
ASME-AIEE National Power Conference, St. Francis Hotel, San Francisco, Calif.

September 24–27, 1961
ASME Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

October 4–6, 1961
ASME Process Industries Conference, Shamrock Hilton Hotel, Houston, Texas

October 17–19, 1961
ASME-ASLE Lubrication Conference, Morrison Hotel, Chicago, Ill.

November 26–December 1, 1961
ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(*For Meetings of Other Societies, see page 115.*)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers, 50 cents; to ASME members, free. Also available on request is a "Schedule of Program Planning Dates for Meetings and Publication Deadline Dates." Ask for Form M&P 1315.

1961 ASME Textile Engineering Conference to Discuss Shuttleless Looms, Mechanics of Ginning and Manufacturing, Quality of Cotton

THE 1961 Textile Engineering Division Conference of The American Society of Mechanical Engineers will present papers dealing with two major topics: Shuttleless looms and the mechanics of ginning, manufacturing, and quality of cotton.

The conference will be held at Clemson College, Clemson, S. C., on Thursday and Friday, March 16–17, 1961.

Also featured in the technical program is a panel discussion on nonwovens and their method of manufacture. Panel members will include faculty members from Clemson College and representatives of the textile industry from New England and the South.

Part of the Conference is set aside for industrial tours of Clemson College School of Textiles and the U. S. Department of Agriculture Spinning Plant and Ginning Laboratory. In addition, there will be tours of the Saco-Lowell Facilities at Clemson.

Some of the social events include a social hour followed by a banquet on Thursday evening to which wives and guests are invited. An attractive program has been arranged especially for the women.

The following travel service for the convenience of conferees from New England and the New York area is offered. Arrangements have been made with the Southern Railway to have a special pullman car, made up of roomettes and bedrooms, to be attached to their train, "The Southerner." This train will depart from Pennsylvania Station, New York City, on Wednesday, March 15, at 3:25 p.m. and will arrive at Clemson at 7:10 a.m. on Thursday, March 16. Persons wishing to attend this conference also will be picked up en route between New York and Lynchburg, Va.

For the return trip the special pullman will be attached to the Southern Railway's train, "The Peach Queen," and will leave from Clemson at 4:08 p.m. on Friday, March 17, and is due to arrive at Pennsylvania Station, New York City, on Saturday, March 18, at 10:55 a.m.

▶TUESDAY, MARCH 16

Session 1 **9:30 a.m.**

The Development and Potential of Nonwovens, by *T. D. Efland*, School of Textiles, Clemson College, Clemson, S. C.

Panel Discussion: **Nonwovens and Their Method of Manufacture**

Panel Members:

T. D. Efland, School of Textiles, Clemson College, Clemson, S. C.

J. W. Powischill, School of Textiles, Clemson College, Clemson, S. C.

James Hunter, J. E. Hunter Co., North Adams, Mass.

Howard H. Langdon, Curlator Co., East Rochester, N. Y.

Maurice A. Goldman, Fibre Products Labs., Inc. Newark, N. J.

R. D. Williams, Celanese Fibers Co., Charlotte, N. C.

Luncheon Clemson House 12:30 p.m.

Industrial Tours 2:00 p.m.

Group 1—Saco-Lowell Research and Development Center, Clemson, and Saco-Lowell Easley and Demonstration Area

Group 2—Clemson College, School of Textiles and U. S. Dept. of Agriculture, Pilot Spinning Plant and Ginning Lab.

Social Hour Clemson House 6:00 p.m.

Dinner Clemson House 7:00 p.m.

▶FRIDAY, MARCH 17

Session 2 **9:30 a.m.**

The Shuttleless Loom, a Review, by *A. E. McKenna*, School of Textiles, Clemson College, Clemson, S. C. (Paper No. 61—Tex-3)

The Maxbo Shuttleless Loom, by *R. J. Farr*, Edda International Corp., Greenville, S. C. (Paper No. 61—Tex-2)

The Draper Shuttleless Loom, by *Donald Marshall*, Draper Corp., Spartanburg, S. C.

Cotton—Mechanics of Ginning and Effects on Quality, by *J. A. Luscombe*, Cotton Ginning Investigation, U. S. Dept. of Agriculture, Clemson, S. C. (Paper No. 61—Tex-1)

Cotton—Some Aspects of Quality as Related to Manufacturing, by *J. E. Ross*, Agricultural Marketing Service, U. S. Dept. of Agriculture, Clemson, S. C. (Paper No. 61—Tex-4)

WOMEN'S PROGRAM

▶THURSDAY, MARCH 16

8:00 a.m.—12:00 noon—Registration, Clemson House

Coffee Hour. Information is available about local points of interest.
1:00 p.m.—Dutch Luncheon, Clemson House
2:15 p.m.—Tour of Student Center, Calhoun Mansion, and architectural exhibits.
6:15 p.m.—Women are invited to attend Social Hour and Banquet at 7:00 p.m.

▶FRIDAY, MARCH 17

10:00 a.m.—Automobile tour of campus, residential area, and other points of interest.

Availability of Papers by Mail

ONLY numbered ASME papers in this program are available in separate copy form until Jan. 1, 1962. Prices are 50 cents to members of ASME, $1 to nonmembers, plus postage and handling charges. Payment may also be made by free coupons, or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nonmembers. **You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to: ASME Order Department, 29 West 39th Street, New York 18, N. Y.** Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the conference.

ASME Maintenance and Plant Engineering Conference to Seek Ways Plant Engineers Can Help Management Meet Challenges of Competition

THE American Society of Mechanical Engineers Maintenance and Plant Engineering Division Conference will be held at the Bancroft Hotel, Worcester, Mass. This conference, which is gaining more and more recognition in the field, will be in session on Monday and Tuesday, April 10–11. The Worcester Section of ASME will be host to the fourth annual meeting. A well-rounded program has been planned.

One of the high lights of the conference is the Maintenance Forum, to be held on Tuesday. Discussion will be directed to the timely topic, "How Can the Plant Engineer Help Management Meet Competitive Prices?" B. G. Evans, manager, Engineering Maintenance Department, Eli Lilly & Company, will act as moderator. Other panel members include speakers from General Electric Company, Monsanto Chemical Company, The Norton Company, and the Carbide and Carbon Chemicals Company. Topics for discussion will be solicited during previous sessions of the conference as well as the questions from the audience during the forum.

An inspection trip of The Norton Company has been arranged. This company is one of the largest in the world producing abrasives, grinding wheels, grinding and lapping machines, and encapsulating equipment.

Another feature of the conference is the banquet, which will take place at 7:00 p.m. on Monday. K. P. Powers, Chairman of the ASME Maintenance and

Plant Engineering Division, will preside.

A program for the women has been planned and is highlighted by an excursion to Old Sturbridge Village. Re-created on a 200-acre tract, the village is a typical farming community of the early 1800's.

▶ MONDAY, APRIL 10

Session 1 **9:30 a.m.**

Maintenance-Cost Reduction and Control In a Paper Mill[1], by *C. V. Clarke*, H. B. Maynard and Co., New York, N. Y.

Effective Preventative Maintenance Job-Scheduling System[1], by *K. M. Smith*, Caterpillar Tractor Co., Peoria, Ill.

Maintenance Improvement and Cost Control,[1] by *A. Chapman*, Ford Motor Co., Dearborn, Mich.

A New Tool for Maintenance-Cost Control,[1] by *E. A. Rachal* and *R. E. Dougher*, E. I. du Pont de Nemours and Co., Inc., Aiken, S. C.

Session 2 **2:30 p.m.**

The Role of Lubrication in Preventive Maintenance,[1] by *T. R. Witt*, Tennessee Eastman Co. Division of Eastman Kodak Co., Kingsport, Tenn.

Standardization of Lubrication Equipment Locations on Machinery,[1] by *R. C. Garretson*, Westinghouse Corp., Pittsburgh, Pa.

Fuels and Lubricants for Industrial Trucks,[1] by *N. T. Brenner*, Gulf Research and Development Co., Pittsburgh, Pa.

▶ TUESDAY, APRIL 11

Session 3 **9:30 a.m.**

How Can the Plant Engineer Help Management to Meet Competitive Prices

Panel Members:

A. W. Cole, Union Carbide Division of Carbide and Carbon Chemicals Co., S. Charleston, W. Va.

A. F. Hardy, Jr., The Norton Co., Worcester, Mass.

W. M. Kell, General Electric Co., Lowell, Mass.

C. Knight, Monsanto Chemical Co., Springfield, Mass.

J. Vonderheide, General Electric Co., Louisville, Ky.

Session 4 **2:30 p.m.**

Reduction of Maintenance Costs With Teflon Fluorocarbon Resins,[1] by *R. D. Pillsbury*, E. I. du Pont de Nemours and Co., Inc.

The Use of Laminated Safety Glass in Industria Plants,[1] by *W. E. Seuberling*, Monsanto Chemical Co.

Vinyl and Epoxy Resins in Maintenance[1], by *McKnight*, Union Carbide and Chemicals Division, Carbon Chemicals Corp., Bound Brook, N. J.

[1] Paper not available—see box on this page.

Availability of Papers

No papers were available when this program went to press, therefore please do not order any papers listed in this program. The final listing of available technical papers wi'l be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference. Prices are 50 cents to members of ASME, $1 to nonmembers, plus postage and handling charges. Payment may also be made by free coupons, or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nonmembers. **You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to: ASME Order Department, 29 West 39th Street New York 18, N. Y.** Papers must be ordered by the paper numbers otherwise the order will be returned.

Engine Fuels and the Future—Theme of 1961 ASME Oil and Gas Power Conference and Exhibit, Jung Hotel, New Orleans, April 10–13

BECAUSE of the effect on the internal-combustion-engine industry of constantly changing fuel characteristics and supplies, the theme of the ASME Oil and Gas Power Division Conference and Exhibit is "Engine Fuels and the Future." Dates of the conference are April 10–13, 1961, and the Jung Hotel is the site of the meeting and exhibit.

The Technical Program Committee reports that the papers which are to be presented cut across all segments of the internal-combustion-engine industry including engine builders, engine users, as well as suppliers.

It is too early to list specifically the papers to be presented; those currently under review by the committee should appeal to the broad interests of everyone concerned in any way with internal-combustion engines. They run the gamut from highly technical treatises to the practical dollar-and-cents case histories by operating personnel.

Special Lecture. One of the outstanding features of the 33rd Annual OGP Conference and Exhibit is the "Special Lecture" to be presented by Martin Elliott, director, Institute of Technology, Chicago, Ill. His talk will cover the role of fossil fuels in supplying energy demands. Dr. Elliott will further discuss projections of energy demands, the availability of natural petroleum and natural gas and the long-range problem of synthetic liquid fuels and synthetic pipeline gas from coal and oil shale. His talk will briefly touch upon nuclear energy. Competitive problems of the various fuels and a discussion of the economics of synthetic liquid and gaseous fuel production will be encompassed in his lecture. Dr. Martin indicates, also, that he may devote a portion of his talk to new power-generation techniques such as thermoelectric devices, thermionic devices, fuel cells, and magnetohydrodynamic generators.

Copies of Dr. Elliott's paper will be available immediately after his lecture.

Honors. L. V. Armstrong and Dr. Paul H. Schweitzer have been nominated to receive the Oil and Gas Power Division Citations . . . "for distinguished service in the application of diesel engines for stationary and marine power and for significant contributions to the technical literature on diesel engine design and operation." Speakers' Awards will be presented to Fred A. Robbins for his paper "Piston Ring Design and Application Practices for Modern Large Bore Diesel and Gas Engines," and to A. N. Addie for a paper entitled "Design and Development of Turbochargers for General Motors Corporation's Series 567 Engines."

"What's New." At each of the recent conferences, "What's New" has been an interesting and informative portion of the program. Each exhibitor is allowed three minutes to discuss recent and significant developments for which his company is directly responsible. The popularity of "What's New" is manifested in the fact that some 20 companies made their terse presentations to capacity attendance during the 1960 Conference. "What's New" will again be one of the high lights of the New Orleans meeting.

Exhibits. Vital to the conference are the exhibits that will bring the ever-changing panorama of new ideas and wares to the attention of conference registrants and exhibit visitors. Here manufacturers of products and services can freely discuss their major advances. Here also is where the experts gather to look, learn, and exchange ideas while relaxing in the individual exhibits and during the social hours in the exhibit area.

As of December, 20 companies will be represented with exhibits: Van der Horst Corporation of America; The Cooper-Bessemer Corporation; The Bendix Corporation; Reagan Equipment Company; Koppers Company, Inc.; Wm. W. Nugent & Co., Inc.; American Bosch Division; Harper Packing Company; Amot Controls Corporation; Diamond Chain Company, Inc.; The Hilliard Corporation; Alnor Instrument Company, Division of Illinois Testing Laboratory; Engineering Controls, Inc.;

Woodward Governor Company; Ren Equipment Company, Inc.; Robertshaw-Fulton Controls Company; Nordberg Manufacturing Company; Wilkening Manufacturing Company; North Electric Company; and Fairbanks, Morse & Company.

Typically, the companies represent the industry as a whole, encompassing engine builders and suppliers. J. T. Adams, chairman of the Exhibits Committee states that the exhibit arrangements at the Jung Hotel are ideal inasmuch as all conference attendants must enter and leave the technical sessions through the exhibit area providing a distinct advantage for the exhibitors.

As in previous ASME-OGP exhibits, a registration fee is not required of those visiting the displays only.

Social Events. Not to be overlooked are the social events which have been planned by the New Orleans Section. To date these are the events which warrant greatest interest:

Sunday, April 9th: Get Acquainted Party will be held at the Jung Hotel in the evening. A film depicting high lights of the city also may be shown.

Monday, April 10th: Women will enjoy a tour of Garden District Homes, leaving by bus from hotel at 1:30 p.m. The tour will end in the vicinity of Commander's Palace where coffee and sherry will be served on the Patio.

Tuesday, April 11th: Women will be taken by bus to Esplanade Wharf from Jung Hotel at about 11:00 a.m. where they will tour the historic *River Queen* and will enjoy a luncheon on board. Following lunch at dockside, ladies will be taken to Canal Street Dock to join the men for a harbor trip and social outing on the steamer "President." In the offing during the harbor trip is the possibility of a demonstration of the new Higgins Industries boat with hydrofoil hull.

Wednesday, April 12th: Women will be taken to breakfast at Brennan's on Royal Street at 10:00 a.m. and continue on a "French Quarter Patio Tour." The Annual OGP Division Banquet will be held at 7:00 p.m. with H. R. Sennstrom, OGP Chairman, presiding. Presentation of the honors and awards will be made during the banquet. The special speaker for the banquet will be announced at a later date.

On Monday, Wednesday, and Thursday the OGP Division will sponsor its usual "Social Hours" in the exhibit area. In addition, there will be the usual morning coffee hours for the women in attendance, and also under consideration, but limited to specific request, will be arrangements for private parties to visit the Kaiser Aluminum & Chemical Corporation Plant at Chalmette, La., where 80 Nordberg gas-burning radial engines produce approximately 150,000 hp.

At the close of the Executive Committee meeting of the OGP Division in New York on Nov. 29, 1960, Harold Sennstrom, chairman, expressed great enthusiasm about the plans as they were shaping up for the 33rd Annual Conference and Exhibit. He states: "I urge every engineer interested in the oil and gas power industry to attend. Every engineer who attends the Conference and Exhibit will certainly gain much of value which can be applied to the solution of his daily problems."

ASME to Sponsor Several Sessions at 1961 Meeting of American Power Conference

Many sessions at the 1961 meeting of the American Power Conference, of which The American Society of Mechanical Engineers is one of the major sponsors, will be of particular interest to the general membership of the Society.

The meeting will be held on March 21–23, at the Sherman Hotel in Chicago, Ill., and features five sessions sponsored by ASME. Four of these will be sponsored by the Power Division and one by the Fuels Division.

Supercritical Power Plants. The two Central Station sessions sponsored by the Power Division will be devoted to design and operating experiences with two of the nation's leading supercritical power plants—the Avon Station of the Cleveland Electric Illuminating Company and the Breed Station of the American Electric Power Company.

Power-Plant Auxiliaries and Air-Pollution Control. The sessions on power-plant auxiliaries and air-pollution control also sponsored by the Power Division will contain a variety of papers dealing with flash evaporators, steam-turbine drives, boiler feedpumps, fly-ash collectors, and the aerodynamic and meteorological factors affecting stack-effluent dispersal.

Fire-Side Corrosion of Boiler Surfaces, Sulfur Removal From Coal, and Pulverizer Design Effect on Furnace Control. The Fuels Division session will present papers covering fire-side corrosion of high-temperature boiler surfaces, sulfur removal from coal, and effect of pulverizer design on furnace control.

In addition, the luncheon to be held on Tuesday, March 21, will be sponsored by ASME, and President W. H. Byrne will preside. The speaker on this occasion will be Sherman Knapp, president of the Edison Electric Institute.

A brief résumé of the sessions and topics to be covered is outlined in the following. Persons interested in obtaining copies of the complete program together with registration information should write the Director, American Power Conference, Illinois Institute of Technology, Technology Center, Chicago 16, Ill.

▶ TUESDAY, MARCH 21

10:00 a.m.—Opening Meeting
12:15 p.m.—ASME-Sponsored Luncheon
2:00–5:00 p.m.—Central Stations 1, The Avon Supercritical Station[1]
Water Technology 1, Condensate Polishing
Transmission—Electrical
Space Heating
Industrial-Electrical
7:30 p.m.—Forum: Future Methods of Energy Conversion

▶ WEDNESDAY, MARCH 22

9:00 a.m.–12:00 noon—Central Stations 2, The Breed Supercritical Station[1]
Water Technology 2, Ion Exchange Operations
Fuels[1]
Automation and Control—Electrical
Industrial Plants and Industrial Space Heating
Hydroelectric Peaking
12:15 p.m.—AIEE-Sponsored Luncheon
2:00–5:00 p.m.—Thermal Peaking
Water Technology 3, High Purity Water
System Planning and Operation—Electrical
Steam-Generator Auxiliaries
Industrial Training
6:30 p.m.—All Engineers Dinner

▶ THURSDAY, MARCH 23

9:00 a.m.–12:00 noon—Central Stations 3
Power-Plant Auxiliaries[1]
Industrial Water Treatment
Distribution—Electrical
Nuclear Power 1
12:15 p.m.—Western Society of Engineers Luncheon
2:00 p.m.–5:00 p.m.—Central Stations 4
Air-Pollution Control[1]
Economics of Industrial Plant Operation
Apparatus—Electrical
Nuclear Power 2
Computers and Network Analyzers—Electrical

[1] Sessions sponsored by ASME.

Conducted for the National Junior Committee

J.W. FOLLANSBEE[1]

JUNIOR FORUM

The Engineer as a Writer

By Stewart H. Ross[2]

Literature is not an abstract science, to which exact definitions can be applied. It is an art, rather, the success of which depends on personal persuasiveness, on the author's skill. *Sir Arthur Quiller-Couch*

WHY does the engineer write? He writes to educate, to command, to cajole, to inform, to request, to placate—to communicate his needs, demands, discoveries, and feelings. In short, he hopes to influence someone's actions or someone's thoughts.

Today, with increasing size and complexity of engineering departments, the engineer relies on formal written rather than informal verbal communication. The young engineer often cannot talk to his manager—much less the chief engineer—face-to-face. So, he must write to him. In a two-way conversation, the puzzled frown of incomprehension registering on the listener's face is a clue to recourse to a new tack of explanation; in a report, you have only one chance. You must write so the reader gets only one interpretation of your message—and that single interpretation must be obvious.

Three Kinds of Readers. Sometimes your reader is captive; he has been anxiously awaiting your data and he vitally needs all of it. However, if you write incomprehensibly, he won't like it—but he will give your communication careful attention.

Most engineers are not so fortunate. They write for busy readers. Therefore the incomprehensible report in the stack on the manager's desk is one of many important ones competing for his attention. If you write incomprehensibly, he will be annoyed and your message will go unheeded.

Finally, there is the reader who is not certain at all that what you are trying to say is important to him. Not only must you hold this reader securely—almost against his will—but you must instantly create the desire on his part to read your message; what you say is important to him. You must write interestingly for this kind of reader, and this requires great skill.

What follows is directed at those writing for the busy reader, particularly those who find that only rarely do they get results from their writing. If you fit into this category, you probably also have an inferiority complex when it comes to writing. But if you speak English with ordinary fluency, you should be able to write about as well. Remember, word treatment in writing is just one of the means—a most important one—to be used in getting ideas across.

Important Message Is Important. First, you must have something to say, important enough to justify your efforts, and ultimately the reader's. (If you have nothing to say, save it for your bull-sessions; don't write it to your manager.) Then, decide who your reader will be. Find out as much as you can about his personality. What is the extent of his knowledge, his likes and dislikes, his interests, his capacity for understanding and his limitations, and any peculiarities he has that might influence his receptivity for your information. What should he know? What must he know? Awareness of your reader is the first ingredient of good writing.

Before you start to write, you should have a plan. Some engineers always use a written outline; some engineers never use a written outline; others use an outline occasionally. Suit yourself. Short letters and memoranda scarcely need any planning at all, since they contain only one idea. Long reports, containing many different ideas, must have related ideas and supporting details properly integrated, so the reader will smoothly assimilate the facts.

A Road Map. Consider your outline a map for your reader to follow. Help him to know approximately where he is, how he got there, and generally in what direction he is going. Later you will be able to tell him more precisely the route to be followed. If you provide no map, the reader will try to make his own—or lose his way.

No one should tell you how to organize your ideas. Although most engineering reports follow a logical format—introduction, work done, results, conclusions, recommendations—there is plenty of room for fresh, original ideas. Don't try to be different just to be distinctive, but strive for an approach that will make the job for the reader as easy as possible.

Remember—the author with the most ideas must be the most cautious of his organization.

The Rough Draft. Establish the most logical grouping of ideas. Then, as quickly as possible, put down every thought, disregarding the niceties of sentence structure, punctuation, grammar, (even spelling). This hastily written first draft, with attention focused only on ideas—not style—generally reflects almost exactly the writer's speech habits.

As you prepare this first draft, do not view your performance critically, and do not stop periodically to read over what you've written. This shifting of the focus of attention from the subject matter to its form of expression is a common failing. The best writing always is accomplished in one uninterrupted burst of exerted effort.

This first draft will be, appropriately enough, your rough draft. If this rough draft contains all your ideas, arranged according to your plan, be satisfied with it.

Some authorities claim the rough draft immediately should be bundled into a dark drawer and allowed to ferment unmolested, at least overnight. This is a good practice to follow, if you have the time. Next morning you will be more objectively critical in your editing.

Rules for Readability. Many writers mistakenly assume that what lies ahead—the editing—is the homestretch, for they've already completed most of their work. Actually, the most time-consuming and most important part of the author's job lies ahead. What remains to be done is addition of the polish of readability, and this takes strenuous effort.

Authorities generally agree that the following ingredients will help the reader. The order in which they are listed is haphazard; choose for yourself which to emphasize.

1 Good Diction—the most obvious

[1] Designer, Voorhees, Walker, Smith, Smith & Haines, New York, N. Y. Assoc. Mem. ASME.

[2] Engineer—Publications, Ordnance Department, General Electric Company, Pittsfield, Mass. Assoc. Mem. ASME.

flaw, the shortcoming most certain to set the reader against you, to cause him to doubt the validity of every one of your statements, is poor diction. This is marked by inappropriate or downright inaccurate choice of words and their arrangement. By contrast, a technical piece that uses words with precision will draw the reader to your side and make him sympathetic to your cause.

2 Accuracy—there is no excuse for an engineer to write inaccurately. The engineer's judgment may falter, his decisions may be wrong, but his data must never be in question. Better leave unsaid any information of doubtful accuracy; misleading information can cost your company money. Spare no efforts to achieve absolute accuracy, and be honest!

3 Consistency—like bad diction, inconsistent spelling, punctuation, or style is sure to give the reader the impression you don't know what you are talking about. Set aside a special final edit to check for inconsistencies.

4 Completeness—the report that delivers an incomplete message is about as worthless as the one that hides its message under a shroud of obscurity. Make certain your plan sets a goal of minimum coverage for you—what you must say to tell your story—and stick to it. Sometimes you can include too much substantiating information. But if a choice must be made between conciseness and completeness, remember that the reader can discard irrelevancies; he cannot create relevant information on the spot. "Be concise" is the most overworked slogan of all. Attempts at ultra-conciseness can lead to reader frustration.

5 Variety—bore your reader with same-looking sentences, same-length paragraphs, same-sounding words, and you lose him. Make a particular effort to vary sentence and paragraph length. If you carefully punctuate long sentences you will not lose your reader. Follow a complex idea with a simple one. Add special "refresher" words for emphasis, such as definitive adjectives, which are calculated to buoy up a sagging jowl. Remember—a reader is receptive only when stimulated.

6 Active Verbs—make the verb your workhorse. Punch your reader with energetic verbs to add vital color to drab surroundings. You gain nothing by saying: "Grass is eaten by the cow," instead of "the cow eats grass."

Tools of the Trade. To add these ingredients, certain tools can be a big help. You need a modern dictionary at your desk. "The American College Dictionary" contains the highest percentage of technical words; don't get a "technical" dictionary; the best are incomplete. A companion piece to the dictionary is a book covering usage. "A Dictionary of Contemporary American Usage" or "A Dictionary of American-English Usage" will fill you in on grammar, style, word preference, and punctuation.

Self Assessment. When you have finished your editing, is it possible to assess the quality of the finished product? It is difficult for two people to agree on what is "good" writing. What can be established is agreement on what is "bad" writing. If readers agree they do not understand a certain piece of writing, they are apt to agree to its being "bad" writing.

About all you can rely on regarding the quality of your writing is the effectiveness of your message. Did you get the results you were after? You cannot often depend on valid criticism of your style and approach by your supervisor.

Probably he has become so accustomed to obscure writing, this is the norm he has come to expect.

Good writing, then, in the absence of black-and-white standards, is clear writing, understandable to nearly all who might be motivated to read it (for any reason), but particularly comprehensible to the pre-established audience.

On the Other Hand

As J. W. Follansbee Sees It. The article you've just read is fairly well put. The author has given you his views on the subject, based on observation, experience, and ideas. In some places he seems to skate on thin ice, so I'm adding comments of my own to give you a broader view of this subject. You may not agree with either one of us; or you may have questions. In either case get in touch with either Stewart Ross or me through the Mechanical Engineering office.

On Road Maps. Tell your reader, first thing, where he's going—that is, where you're taking him. Then take him there. Don't sidetrack. Finally, tell him he's arrived and how he got there. Put these signposts in the body of your work, in an abstract, synopsis, summary, or a combination of all. This is repetition, but it's worth it.

On Active Verbs. Listen well to Mr. Ross. But—don't overdo it. Too many passive verbs and your reader dies of boredom or impatience; too many active verbs and you beat him to death. Mix them up. Emphasize active tense, but don't neglect passives. Variety, variety, variety: Use it here as well as with sentence length, paragraph length, and long and short words.

On Self Assessment. This is tough. Yet there is a source of self assessment Stewart missed that I think is vital. Enlist outside help, especially if your friend is not technically trained. You won't have the time to run outside on every report; but if the piece is important, get someone either not in your department or not in the company to read it over. If the layman can get the message, you can bet money your manager will get it faster. And that's what you want. Your outside help will probably criticize sloppy, confusing, egoistic writing a whale of a lot faster than an engineering friend.

1961 RAC Meetings Schedule

Date	Days	Location	Hotel	Region	Section
March 27–28	Mon.-Tues.	Lancaster, Pa.	Stevens House	III	Susquehanna
Apr. 4–5	Tues.-Wed.	Tulsa, Okla.	Ramada Inn Motel	X	Mid-Continent
Apr. 7–8	Fri.-Sat.	Seattle, Wash.	Edmund Meany	IX	Western Washington
Apr. 15–16	Sat.-Sun.	Atlanta, Ga.	Henry Grady	IV	Atlanta
Apr. 19–20	Wed.-Thurs.	Denver, Colo.	Denver-Hilton	VIII	Rocky Mountain
Apr. 21–22	Fri.-Sat.	Kansas City, Mo.	Muehlebach	VII	Kansas City
Apr. 24–25	Mon.-Tues.	Dayton, Ohio	Van Cleve	V	Dayton
Apr. 28–29	Fri.-Sat.	Louisville, Ky.	Sheraton	VI	Louisville
May 1–2	Mon.-Tues.	Suffern, N. Y.	Motel on the Mountain	II	North Jersey
May 5–6	Fri.-Sat.	Waterbury, Conn.	Roger Smith	I	Waterbury
Palm Sunday	March 26				
Good Friday	March 31				
Easter Sunday	April 2				

ASME CODES AND STANDARDS WORKSHOP

V-Belt Standard Ready for Approval
Wood-Plastic "Alloy" Cracks Design Barrier
By C. Carmichael, Editor, Machine Design

SPONSOR and ASA approval is all that is needed to put another important standard into effect. The proposed American Standard Specifications for Multiple V-Belt Drives has received the final touches from its sectional committee, which is jointly sponsored by The American Society of Mechanical Engineers and the National Machine Tool Builders' Association.

In the works since 1949, when ASA Sectional Committee B-55 took over direction of the program, the new standard sets the dimensions and horsepower ratings of V-belts and sheaves in the A, B, C, D, E series, for industrial use. Automotive, agricultural, and appliance applications, covered by other specifications, are not included in this standard.

To be designated ASA B55.1-1961, the standard is based on Engineering Standards, Multiple V-Belt Drives (1955 edition), published jointly by the Multiple V-Belt Drive and Mechanical Power Transmission Association, representing the sheave manufacturers, and the Rubber Manufacturers Association Inc., representing belt manufacturers.

Two significant revisions, made during the past year, have simplified the standard: 1. The number of preferred belt lengths was reduced from 49 to 38; 2. Tabulation of horsepower ratings was reduced from two ("standard quality" and "premium quality") to one, which is the standard, but for which the ratings are equal to the former premium values.

Copies are available from ASME Order Dept., 29 West 39th St., New York 18, N. Y.

Correction

"Pipe Threads (Except Dryseal) ASA B2.1-1960." The following correction has been called to our attention: On page 13, Table 4, change the first two values to read: 0.340 and 0.442.

The Council Meetings

Actions of the 1960 Council

THE Council of The American Society of Mechanical Engineers met in four sessions during the 1960 Winter Annual Meeting in the N. Y. Dental Society Headquarters in the Statler Hilton Hotel, New York, N. Y., on Sunday, November 27, at 9:45 a.m., adjourning at 12:00 noon; and convening at 2:15 p.m. and adjourning at 3:40 p.m.; Monday, November 28, at 9:40 a.m., adjourning at 11:45 a.m.; reconvening at 2:45 p.m. and adjourning at 2:50 p.m.

Attendance. Attendance at all sessions, unless otherwise indicated, was as follows:

Council—President, Walker L. Cisler.

Past-Presidents, J. N. Landis, W. F. Ryan, and G. B. Warren.

Vice-Presidents, C. H. Coogan, Jr., T. J. Dolan, Harold Grasse, G. R. Hahn, W. C. Heath, J. W. Little, D. E. Marlowe, and H. N. Muller.

Directors, E. M. Barber, E. O. Bergman, R. G. Folsom, C. C. Franck, Sr. (Monday), E. W. Jacobson, W. H. Larkin, A. M. Perrin, L. N. Rowley (Sunday), R. B. Smith, and V. W. Smith (Monday).

Treasurer, E. J. Kates.

Council-Elect—President, William H. Byrne.

Vice-Presidents, D. J. Bergman, E. H. Draper, A. H. Jensen, R. C. Robertson, and G. B. Thom.

Directors, J. B. Jones and R. S. Stover.

Past-Presidents—J. W. Barker (Monday) and A. A. Potter (Monday).

Former Members of the Council—E. W. Allardt and A. C. Pasini.

EIC Representative on ASME Council—H. G. Conn.

Chairmen and Members of Boards and Committees—Organization: F. L. Schwartz (Sunday morning and Monday), J. H. Harlow (Monday morning), and C. H. Shumaker (Sunday afternoon and Monday morning); Constitution and By-Laws: R. W. Miller (Sunday), T. A. Wetzel (Monday morning); Finance: E. J. Schwanhausser (Monday); Board on Technology: Kerr Atkinson; Meetings: W. B. Wilkins (Sunday afternoon and Monday morning); Nominating: W. E. Belcher, Jr. (Monday morning); Engineers Registration: R. W. Worley (Monday morning); National Junior Committee: B. A. Meany (Monday); and Professional Practice: H. A. Naylor, Jr. (Monday morning).

Guests—S. R. Beitler (Sunday morning), D. R. Earich (Sunday), A. K. Ingraham (Sunday), H. H. Snelling, R. L. Nugent, L. S. Romzick, and R. B. Wilson (Sunday).

Secretary—O. B. Schier, II. Assistant Secretaries—W. E. Letroadec (Sunday), W. E. Reaser, S. A. Tucker, and J. D. Wilding.

Staff—J. J. Jaklitsch, Jr., Editor (Monday); H. I. Nagorsky, Controller, D. B. MacDougall, Associate Head, Field Service (Sunday); C. S. Campisi, Staff Assistant, Accounting (Sunday morning); L. S. Dennegar, Public Relations (Sunday afternoon); M. E. McDonald, N. Y. area Salesman, Advertising (Sunday morning); J. M. Meyer, Power Test Codes Department (Sunday morning); R. B. Morgan, Staff Assistant, Meetings and Division (Sunday morning); J. T. Reid, Research; Leslie Scanlan, Field Service (Sunday morning); and C. R. Tunison, Advertising Manager (Sunday morning).

President Cisler introduced the newly elected Council members and the Secretary introduced the following members of staff: C. S. Campisi, R. B. Morgan, and M. E. McDonald.

ASME Staff Members. The Council extended a vote of appreciation in recognition of loyal service to Jean Meyer who served on the staff for 35 years and to Leslie Scanlan who served for 40 years, and presented each with an honorarium for their fine contributions to the work of the Society.

Annual Reports. The Annual Report of the Council was adopted and the reports of the Boards, Committees, and representatives on Joint Activities were accepted as submitted. (The Annual report of the Council was mailed to the entire membership with the January, 1961, issue of MECHANICAL ENGINEERING.)

Woman's Auxiliary. The annual and financial reports of the Woman's Auxiliary were received with expressions of sincere appreciation.

Constitution and By-Laws Committee. Amendments to the Constitution. The Secretary reported that the letter ballot to the membership on the amendment to Article C7, Sec. 5 (Change in the Procedure for Filling Vacancies in the Office of President) resulted in the return of 14,535 ballots of which 116 were defective. The Tellers reported on Nov. 10, 1960, when they canvassed the ballots, as follows: For, 13,915; against, 195; not voting, 309. Therefore, at the Busi-

ness Meeting on Monday afternoon, Nov. 28, 1960, when the results were announced, the amendment became effective.

Amendments to the By-Laws. The Council approved the amendments to Article B5, Par. 2; Article B6A, Pars. 14-E and 15-D; and Article B8, Par. 2. The Council voted to receive for first reading the proposed amendments to Article B2, Pars. 2, 3, 4, 5, and 6; Article B4, Par. 8; Article B6A, Pars. 7, 14, 14-C, 14-C-1, 15, 15-B, 15-C, 15-D, 15-E, 17-B, and 21; Article B6B, Par. 1; and Article B7, Par. 1.

Amendments to the Rules. The Council voted to approve the amendments to Article R5, Rules 2 and 3; Article R10, Rule 2; and Article R11, Rules 8 and 9.

Council Policies. The Council voted to approve the Council Policy P-6.1, Formation and Operation of Sections, Subsections, and Groups. Also the Council approved Council Policy P-6.14 on Research.

Committee on Regional Affairs. Realignment of Region IV. The Council authorized the realignment of Region IV into two regions; (Region IV to consist of the Virginia, Central Virginia, East Virginia, East Tennessee, Greenville, Piedmont Carolina, Eastern North Carolina, and CSRA Sections. Region XI to consist of the Chattanooga, North Alabama-Mississippi, Atlanta, Birmingham, Gulf Coast, Savannah, Northwest Florida, Northeast Florida, Florida, West Palm Beach, and Miami Sections); and the Council authorized the effective date for this realignment to be June, 1962, after the election of a vice-president for the new Region.

Affiliation of Sections With Local Engineering Groups. The Council voted that in the future, any Section desiring affiliation with a local organization must submit the constitution and by-laws of that organization for examination by the legal counsel of the Society and such affiliation must receive approval of the Council prior to such affiliation becoming effective.

ASME Student Section at Brigham Young University. The Council authorized the establishment of the Brigham Young University Section of ASME, the mechanical-engineering curriculum having been approved by ECPD.

Discontinuance of the Texas City Area Group. The Council voted to dissolve the Texas City Area Group of the South Texas Section.

Definition of an ASME Student Member. The Council voted to recommend to the Constitution and By-Laws Committee for their consideration of the following amendment to Article C4, Sec. 7:

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print **ASME Master-File Information** Date

LAST NAME FIRST NAME MIDDLE NAME

POSITION TITLE NATURE OF WORK DONE
e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

*☐
EMPLOYER'S ADDRESS City Zone State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐
HOME ADDRESS City Zone State

☐
PRIOR HOME ADDRESS City Zone State

* CHECK "FOR MAIL" ADDRESS

I subscribe to

Address changes effective when received prior to:

☐ MECHANICAL ENGINEERING — 10th of preceding month
☐ *Journal of Engineering for Power*
☐ *Journal of Engineering for Industry*
☐ *Journal of Heat Transfer*
☐ *Journal of Basic Engineering*
☐ *Journal of Applied Mechanics* — 20th of preceding month
☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
☐ I—Human Factors Group	☐ R—Railroad	

to delete ". . . in a school having a Student Branch (Section) of this Society" and add ". . . in any engineering school."

Board on Technology. The Council granted permission for the Research Committee on Properties of Steam to undertake an additional fund-raising campaign for $236,000 to cover the cost of the research projects required to extend the 1936 Steam Tables to include the new limits of 15,000 psia and 1500 F.

The Council also authorized the $260,000 fund-raising program of the Research Committee on Corrosion and Deposits from Combustion Gases to provide further investigation into fundamentals of thermochemical reactions influencing corrosion and deposits from combustion gases in boilers and gas turbines.

Also on recommendation of the Board on Technology, the Council voted to endorse the plan of the Meetings Committee to change the format of the Summer Annual Meeting of the Society for 1962; and to request that a written plan be presented to the Executive Committee of the Council at its Feb. 3, 1961, meeting.

Applied Mechanics Reviews. As directed by the Council, the Publications Committee submitted through the Board on Technology, a written report on the *Applied Mechanics Reviews*. The Secretary, after reading the report to the Council, reported that the Board on Technology, at its meeting on Nov. 15, 1960, voted to accept the $50,000 grant from the National Science Foundation for the *Applied Mechanics Reviews* project, these funds to be expended in lieu of contributions from the ASME Development Fund and Southwest Research Institute.

Board on Honors. Appointment of Board Members. The Council approved the interpretation of Article B6A, Par. 16 permitting ASME Medalists to be assigned to the Board on Honors and to request the Constitution and By-Laws Committee to modify Par. 16 to read: ". . . (2) of whom are to be either corporate Honorary Members of the Society or ASME Medalists who are corporate members of the Society."

Research Executive Committee. Research Committee on Effect of Nuclear Radiation on Materials of Construction. The Council established a Research Committee on Effect of Nuclear Radiations on Materials of Construction with the following personnel: M. A. Cordovi, R. C. Dalzell, R. P. Felgar, Glenn Murphy, Robert Plunkett, and R. H. Shannon.

Committee on Group Disability Insurance for ASME Members. Additional Coverage. After consideration of the report on High-Limit Accident, Death, and Dismemberment Insurance Plan, prepared by Smith, Sternau and Son, and on recommendation of the Committee on Group Disability Insurance for ASME Members, the Council approved the addition of High-Limit Accident, Death, and Dismemberment Insurance to the existing Group Insurance for ASME Members Program; and authorized the Trustee for the program to sign the application for a master policy after all pertinent documents have been reviewed and approved by the Committee. Further the Council voted to commend the Committee for its excellent work on behalf of the members of the Society.

Intersociety Relations Committee. Report. R. B. Smith, chairman of the Intersociety Relations Committee, reported on progress which has been made by the Committee to date in the formulation of a Unity plan. The Council instructed the ASME Representatives to ECPD to reject the proposed amalgamation of EJC and ECPD submitted on Oct. 8, 1960; to receive the progress report of the Intersociety Relations Committee; and to send copies of the report to all Sections of the Society.

Member Gifts Campaign. Report. W. H. Larkin reported on the progress made in the Member Gifts Campaign. Subsequently, each of the eight Vice-Presidents reported on their current efforts. E. W. Allardt, past Vice-President of Region V, was called upon to give a review of methods which he used and found successful.

United Engineering Trustees. Sale of Engineering Societies Building. The Council authorized the Secretary to designate representatives as needed in the event that W. F. Thompson, H. E. Martin, or F. S. Blackall, jr., ASME Representatives to UET, are unable to attend the meeting of the UET when the closing of the sale of the building and property at 29 West 39th Street will take place.

National Council of State Boards of Engineering Examiners. Model Law. The Council voted to endorse the Model Law relating to the Practice of Professional Engineering.

Certificates of Award. ASME Lecturers, 1959–1960. The certificates of award have been prepared for the following: Samuel B. Batdorf, Kenneth E. Bisshopp, Renato Contini, Robert G. Dean, Jr., Harold M. Faigenbaum, Nicholas J. Hoff, William Littlewood, Admiral Andrew I. McKee, Maynard M. Miller, Dwane Orton, and Allison K. Simons.

Codes and Standards. On recommendation of the B31 Executive Committee and approval of the Board on Codes and Standards, certificates of award have been prepared for the following for outstanding activity in the development of codes and standards formulated under ASME sponsorship: John H. Carson, Joseph A. Cerow, William M. Frame, Frederick A. Hough, Charles G. Martini, and Glen D. Winans.

Retiring Regional Committee Chairmen. Certificates of award have been prepared for the following retiring chairmen of Region I committees: William M. Irving, Student Sections; and Rodger B. Dowdell, Professional Divisions.

Retiring Committee Chairmen. On initiation of their associates and approval of the President, certificates of award have been prepared for the following 1959–1960 committee chairmen: Herbert B. Reynolds, Admissions Committee; Kenneth R. Daniel, Membership Development Committee; Frederick E. Lyford, Membership Review Committee; and Daniel T. Webster, Jr., Professional Practice Committee.

Retiring Section Chairmen. On recommendation of their respective Vice-Presidents, certificates of award have been prepared for the following 1959–1960 Section Chairmen: S. P. Kezios, Chicago; John W. Peterson, Nebraska; William H. Britt, Rochester; Clarence E. Trent, Virginia; Michael Guidon, 3rd, Western Washington; and George S. Stout, Westmoreland.

Appointments. Presidential. E. T. Kirkpatrick, Oct. 7, 1960, Dedication of the Charles A. Dana Auditorium, The University of Toledo, Toledo, Ohio.

Appreciation. To Members of the 1959–1960 Council. President Cisler presented a copy of the translation of Sardi Carnot's book, "Reflections on the Motive Power of Heat," individually autographed by the President, to each member of the 1959–1960 Council. Whereupon, the Council, individually and collectively, voted to extend the thanks of each member of the Council to W. L. Cisler for his personally autographed gift of Carnot's book.

Actions of 1961 Council

The organization meeting of the 1961 Council was held Monday, Nov. 28, 1960, following dinner at the Statler Hilton Hotel in New York City. The retiring president, W. L. Cisler, called the meeting to order at 9:00 p.m. and introduced the past-presidents not on the Council who were in attendance as well as the new members of the Council.

The following were present: President—1960, Walker L. Cisler; and 1961–1962, William H. Byrne.

Past-Presidents: 1961–1962 Council, J. W. Landis, W. F. Ryan, and G. B.

Warren. Retired: E. G. Bailey, J. W. Barker, F. S. Blackall, jr., A. G. Christie, W. A. Hanley, D. W. R. Morgan, E. W. O'Brien, and A. A. Potter.

Vice-Presidents: 1961–1962 Council, D. J. Bergman, C. H. Coogan, Jr., E. H. Draper, Harold Grasse, W. C. Heath, A. H. Jensen, D. E. Marlowe, H. N. Muller, R. C. Robertson, and G. B. Thom. Retired: T. J. Dolan, G. R. Hahn, and J. W. Little.

Directors: 1961–1962 Council, E. M. Barber, E. O. Bergman, R. G. Folsom, C. C. Franck, Sr., J. B. Jones, W. H. Larkin, A. M. Perrin, L. N. Rowley, R. B. Smith, and R. S. Stover. Retired: E. W. Jacobson and V. W. Smith.

Treasurer: E. J. Kates.

Secretary-Emeritus: C. E. Davies.

Secretary: O. B. Schier, II; Assistant Secretaries: W. E. Letroadec, W. E. Reaser, S. A. Tucker, and J. D. Wilding.

Editor: J. J. Jaklitsch, Jr.

Mr. Cisler presented the President's Gavel to Mr. Byrne who took the chair.

Past-President Receives Special Pin. The Council expressed to Walker L. Cisler, retiring President, sincere appreciation and thanks for his accomplishments during his administrative year, during which time he attended many meetings of the Sections, Student Sections, National Meetings of the Society, and sister societies.

President Byrne called upon Past-President Warren to present the special Past-President's pin to Mr. Cisler.

Retiring Members of Council. President Byrne called the roll of retiring members of the Council. Each in turn expressed his appreciation for the opportunity of working with their fellow members in serving the Society and the engineering profession. Those called included: Past-President W. F. Ryan; G. R. Hahn, J. W. Little, T. J. Dolan, Vice-Presidents; and E. W. Jacobson and V. W. Smith, directors.

Appointments. Secretary. The Council voted to appoint O. B. Schier, II, Secretary of the Society for the term ending June 12, 1962; Assistant Secretaries for the term ending June 12, 1962, W. E. Letroadec, W. E. Reaser, S. A. Tucker, and J. D. Wilding; Treasurer, Edgar J. Kates; Assistant Treasurer, Harry J. Bauer. Mr. Kates also was reappointed treasurer of the Development Fund.

Executive Committee of the Council. The Executive Committee of the Council for the term ending June 12, 1962, will consist of W. H. Byrne, chairman; D. E. Marlowe, H. N. Muller, L. N. Rowley, and R. B. Smith.

Assignment of Directors to Boards and Committees. The Council voted to assign Directors and former members of the Council to Boards and Committees in accordance with Article B6A of the By-Laws as follows (Appointments are for one and one-half year terms unless otherwise indicated. New appointments are indicated by an *): Boards—Codes and Standards, E. O. Bergman and C. C. Franck, Sr. (1964); Education, *J. B. Jones; Honors, *J. B. Jones; Membership, L. N. Rowley; Public Affairs, *R. S. Stover; Technology, E. M. Barber (1964), R. G. Folsom (1963), *R. S. Stover (1965), and R. B. Smith (1962); Finance, W. H. Larkin and *A. C. Pasini (1963); and Organization, A. M. Perrin and *W. L. Cisler (1963).

Power Test Codes Committee Chairman (1961–1962). The Council recommended that Wayne C. Astley, vice-chairman of the Power Test Codes Committee, be appointed by his associates as acting chairman pending a letter ballot election of a new chairman.

Delegation of Authority to Boards. The Council delegated certain duties to the following Boards for a term ending June 12, 1962: Board on Technology, Board on Codes and Standards, and Board on Honors.

1961 ASME Summer Annual Meeting. The Council adopted the schedule of meetings at the Los Angeles Summer Annual Meeting, June 11–15, 1961.

Pension Committee. Increase of Benefits. The Council voted to increase, effective Jan. 1, 1961, the maximum of employee life insurance to $25,000, and the equalizing of life insurance for female employees to the same basis for male employees. The Council also voted to institute an Employee Supplemental Life Insurance Plan permitting an employee whose annual salary is in excess of $5000 to subscribe to additional life insurance not to exceed 50 per cent of his annual salary on a contributory basis. For supplemental insurance the employee will contribute $1 per month per $1000 of insurance and the Society to contribute the balance necessary for the purchase of each additional $1000 of life insurance; this program to continue to June, 1965, at which time the Society's contribution will be reviewed.

Engineering Index. Extension of Agreement. The Council voted to extend the present contract of the Engineering Index, Inc., for the year of 1961; the Engineering Index, Inc., to pay $2500 to the Society for the year 1961.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Feb. 24, 1961, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Arizona

Baum, James R., Scottsdale
Poppe, Raymond S., Phoenix

California

●Arenal, Alfonso, Covina
Gratz, Fred M., West Covina
Halseth, Cordiner J., Daly City
Mohr, Siegfried H., San Jose
●Mulvihill, Robert J., San Diego
Waller, Thomas C., 3rd, Alhambra

Colorado

Gauthier, Richard D., Denver

Connecticut

Catlin, John B., Mystic
Kennedy, Richard H., Wolcott
Morris, Robert K., East Hartford
Russell, Donald B., Waterford
Tiedemann, Herman L., Stamford

Delaware

Campbell, James D., 3rd, Newark

District of Columbia

Pulos, John G., Washington

Florida

●Irwin, Claude M., Pensacola

Illinois

●Drenning, James H., Chicago
●Friesth, E. Richard, Moline
Miller, Paul E., Prophetstown

Indiana

Horiak, Erwin A. V., Fort Wayne
Toebes, Gerrit H., West Lafayette

Kentucky

Wade, Paul, West Paducah

Louisiana

Hynds, John P., Shreveport

Maryland

Stepp, Samuel F., Silver Spring

Massachusetts

Entin, Leonard P., Wayland,
Richardson, Herbert H., Framingham

Michigan

Ballauer, Alb C., Menominee
Cerretani, James E., Livonia
Frederick, Julian R., Ann Arbor
Kelly, Olin A., Jackson
●LaValley, Robert J., Detroit
Page, Raymond J., Flint
Rowe, Daniel M., Garden City

Minnesota

Barton, Robert D., Rochester
Fenlason, James M., Rochester
Knutson, Gerald R., Rochester
●Kuhrmeyer, Carl A., St. Paul

●Transfer to Member or Affiliate.

Pexton, Frederic C., Rochester
Saliby, Andrew, Rochester

Mississippi

Lawley, Gene, Sr., Gulfport

Missouri

Mesner, Gustav K., St. Louis

New Jersey

Burns, John M., Phillipsburg
Gaupsas, Walter W., Perth Amboy
Hill, David W., Whippany
Meiers, William E., Florham Park
●Melick, George F., Jr., Murray Hill
Obler, Henry D., Fairlawn
Pasint, Dominic, Carteret

New Mexico

●Dishuck, John J., Kirtland AFB

New York

●Bannerman, Robert A., Brooklyn
Boucher, Francis J., New York
●Fox, Gerald R., Schenectady
Girvin, Edward T., Corning
Goellner, Howard C., New York
Haid, David A., Tonawanda
Hausenbauer, George F., Dunkirk
Hong Moo, Harry L., Schenectady
●Keller, John C., Syracuse
Kennan, Douglas W., Schenectady
Lacerenza, Joseph A., New York
Lewis, David W., Endicott
Moeller, Richard S., Ithaca
●Rayeski, Thomas J., Corning
Ronn, Benjamin, Richmond Hill
Sciutto, Ernest S., New York
Small, Alvah R., New York
●Stephen, Harry M., Schenectady
Walker, Paul, New York

North Dakota

Gronhovd, Gordon H., Grand Forks

Ohio

●Behal, James A., Columbus
Day, Tom R., Jr., Painesville
●Ferguson, Paul E., Cincinnati
Hart, Robert J., Mt. Vernon
Howard, Walter B., Barberton
Jaw, Luis, Massillon

Pennsylvania

Ardizzi, Peter F., Philadelphia
Gibson, Donald J., Pittsburgh
Mowatt-Larssen, Erling, Berwick
Rivers, Hubert M., Pittsburgh
Weaver, George H., Jr., Trevose
Wolff, Thomas P., Reading

South Carolina

Ries, Eugene P., Rapid City

Texas

Crabtree, Leslie C., Lake Jackson
Brown, Norman F., Dallas
Floyd, Clyde M., Baytown
●Kane, John J., Baytown
Kelton, Clifford R., Houston
Lindner, Arlo A., Fort Worth
●Safran, Stephen J., San Antonio

Utah

Ulrich, Richard D., Provo

Virginia

Hoeschel, Helmut G., Covington
Jones, John E., Waynesboro
Pachuta, Michael A., Arlington
Ritchie, William G., Falls Church

West Virginia

●Cason, Roger L., Charleston
Hociota, Nicholas, Follansbee
Williams, Jack B., Sistersville

Wisconsin

Bond, Richard C., Madison
●Enright, Francis J., Milwaukee
●Sipe, James P., Beloit

Foreign

●Benaroya, Alfred, São Paulo, Brazil
Blackwell, Henry C., Camborne, Cornwall, England
LaBounty, George R., Manila, The Philippines
Lane, Alan D., Deep River, Ont., Canada
Rawat, Rudra, Kharagtur, India
Samson, David H., Hamilton, Ont., Canada
Tinneveld, Jack, Glasgow, Scotland, Great Britain
Unnithan, M. K., Quilon, S. India
van Kapel, Hendrik H., Kent Town South Australia

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee. Upon receipt of your application a copy of our placement-fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	29 East Madison St.	57 Post St.

Men Available[1]

Chicago Office

Manager of Research and Development, BSME; 46; 16 years' supervisory experience in research and development on high-speed mechanisms, products and equipment and involving surveys, feasibility studies, kinematic analyses, design, manufacture and development of prototype models, and investigation of special problems. Salary open. Available immediately. Any location. Me-2055-Chicago.

Sales or Application Engineer, BSME; 26; two years' successful experience in application and sales engineering, heating, ventilating, and air-conditioning fields. Three years Navy CE Corps officer. Considerable responsibility in maintenance control, utilities, design department, and, contract administration. $8400. East or Midwest. Me-2072-Chicago.

Inspector or Plant Engineer, four years' college; 59; experienced in food industry and municipal government. Supervision of maintenance, operations, systematic inspections of equipment for safety, and fire prevention. Inspection of heating and air-conditioning installations for city. Any location. Me-2073-Chicago.

Industrial Sales (Technical) or Mechanical Engineer, BSME Univ. of Louisville; 23; six months' experience as field engineer for a leading nationwide communications firm and nine months' co-operative work connected with program at the Univ. of Louisville. $6500. Ohio Valley or South. Me-2074-Chicago.

Manager of Product Development or Engineering, advanced ME degree; PE; 48; 20 years' engineering administrative experience—aircraft, bearings, transportation equipment. Have made contributions resulting in higher sales and profits. Would consider similar position in related product lines. $14,000–$22,000. West and East Coasts, Chicago area. Me-2075-Chicago.

Mechanical Engineer, BSME; 30; experience includes broad responsibilities as field engineer plus three years product design and development; holds patent, other credits. Familiar with automotive industry. Seeks position with real potential growth in direction of management. $9000. Midwest or Southwest. Me-2076-Chicago.

New York Office

Project Engineer, BSME; 29; five years' experience in chemical plant process and plant engineering, drafting supervision, involving new equipment selection, installation, and start-up; experience includes contacts with manufacturers and other engineering departments. $8800. Prefers East. Me-907.

Project Leader, BChE and MS; design and development experience involving analyses in thermodynamics, heat transfer, gas and fluid dynamics, and combustion from both supervisory and administrative levels. Extensive experience in proposal and technical writing. $925 a month. N. Y. metropolitan area. Me-908.

Chief Engineer, MSCE, with experience in structural and mechanical design of industrial structures and machinery in bulk and package handling conveying equipment and earth-moving equipment. Supervision of engineering department of medium size. $12,000–$15,000. Midwest or East. Me-909.

Administrative Engineer, BE (ME;) 14 years staff experience, supervisory responsibilities in plant design, production costs, methods, specifications, purchasing and management liaison. Approximately $18,000. Prefers New York City. Me-910.

Mechanical Engineer, graduate, interested in machine design; approximately one year's experience in design and carry through to prototype and production level. Not afraid of drawing board. $6500. Prefers N.Y.C. metropolitan area. Me-911.

Technical Executive or Metals-Development Manager, BS in Metallurgical Engineering and advanced work; 46; 22 years of excellent experience in research and manufacturing metallurgy extending to both ferrous and nonferrous products. Expert in basic steel processing, foundry products, heat-treatment, welding, specialized metal joining, tool steels, specialized machinery, aircraft products, and machining. Top-level supervision experience at management level. Midwest, East, or South. Me-912.

Development Engineer, BSME, six years' experience reactive metal melting and fabrication development, ceramic fabrication development, fabrication and equipment design and development. Registered PE, Pa. Location immaterial. Me-913.

Director of Engineering, BSEE and MS degrees. Broad technical and management background in the field of electromechanical products, both as components for original equipment and as consumer goods. Working knowledge of related fields—finance and sales. $25,000. Middle Atlantic States or New England. Me-914.

Sales and Marketing Manager, 53; extensive experience setting up and developing national and regional sales organizations selling major engineering mechanical and electrical equipment to utilities, industry, engineering contractors. Also rotary electric Mil-Spec equipment to prime and subcontractors for high altitude, out of space, and ground-support equipment. San Francisco Bay area. Me-915.

Positions Available

Chicago Office

Design and Development Engineers, graduate mechanical and electrical, to 35. Will be responsible for design and development of improvements in present and new products. Supervise construction and testing of prototypes. Prepare necessary papers for application through Underwriters Labs. May perform administrative work in the department as assigned by the manager of engineering. Consult with sales, production, and Underwriters Labs to bring design activities to maximum effectiveness. Will report to manager of engineering. Position with a manufacturer of meter and service equipment and domestic heating equipment. $9000–$11,000. N. H. C-8445.

Chief Engineer, Heat Transfer, mechanical graduate or equivalent, 35–45; to direct activities of small engineering department in design, development, and calculating of engine-cooling radiators, oil coolers, and related heat-transfer surfaces. $10,000–$12,000. Company pays fee. Wis. C-8443.

[1] All men listed hold some form of ASME membership.

Design Engineer, degree preferred, to 50, for the design of "mechanisms" with emphasis on creative ability. Company manufactures pneumatic and electrical tools and hoists and automation machinery. New engineering lab and expanding product line for a manufacturer. $8000–$12,000. Company pays fee. Pa. C-8442.

Mechanical Designers, graduate mechanical, to 45; recent graduates up to five years' experience; one man on single-state centrifugal pumps; the other on reciprocating pump design. Previous experience in design or testing preferred. To $8000. Company pays fee. Mich. C-8438.

Development and Die-Design Engineer, BSME or better. Challenging opportunity for research-minded engineer. Position requires analytical and experimental research in die design for containers and container components for a manufacturer. $10,000–$12,000. Company will negotiate fee. Chicago, Ill. C-8431.

New York Office

Quality-Control Engineer, 25–40, graduate mechanical, electrical, or industrial, three to five years' experience in quality control. Must be familiar with statistical techniques; should be well versed in quality-control sampling techniques and procedures used to provide quality engineering assistance to production departments. Will assume No. 2 technical position in quality-control engineering. $8000–$9500. Apply by letter and indicate present and expected salary. Agency fees, relocation, and interviewing expenses paid by company. Upstate N. Y. W-9961.

Chief Plant Engineer, mechanical or electrical graduate, refrigeration, boiler-plant operation, electrical distribution, and general building maintenance in food-processing plant. $8000–$10,000. Long Island, N.Y. W-9959.

Engineers. (*a*) Maintenance engineer, graduate mechanical, experience in assisting chief plant engineer in planning and directing a complete buildings, equipment-maintenance program. Preparation of plans, estimates, and material requirements for construction projects, heating, ventilating, plumbing, and electrical systems. Liaison with supervisors of skilled craftsmen. Responsible for internal security, safety, and housekeeping programs. $8000–$10,000; excellent fringe benefits. (*b*) Plant-maintenance engineering assistant. $6500–$7500. Southeast. W-9955.

Assistant Sales Manager, mechanical graduate, at least five years' field sales experience in air conditioning. Must be familiar with air distribution. About 50 per cent of time traveling throughout the U. S. $10,000–$12,000. Conn. W-9954.

Engineers. (*a*) Sr. development engineers, to 40, BS, MS, or PhD in mechanical or chemical engineering, or chemistry, five to ten years' experience in research or development, preferably in fibers. Will develop and improve methods and equipment and conduct and supervise pilot-plant tests and trials. Open. (*c*) Product-planning manager, 30–40, graduate engineer, minimum of five years' experience in marketing, product development, and customer service. Will assist in co-ordinating departmental planning efforts in the development of long-range plans for individual products. Open. (*d*) Customer service engineer, 30–45, BS in textile engineering or manufacturing engineering, five to ten years' experience in synthetic fibers or textiles. Will service fibers customers in helping solve problems connected with manufacturing. $8400–$10,200. South. W-9952.

Cost Estimator, five to ten years' experience in medium-sized metal fabrication, familiar with writing process sheets and/or operation sheets, able to estimate tooling, gaging, and labor costs. Open. Conn. W-9948.

Superintendent, Mixing, for Plastics Division, to receive, mix, and color plastics raw materials for subsequent processing by manufacturing departments. Should have had considerable experience in this field. Open. Conn. W-9947.

Product Engineer, graduate mechanical, experienced in air conditioning of large electronic systems and general experience related to installation of electronics systems, for installation work. $10,000–$16,000. Company pays fee. N. J. W-9941 (*a*).

Engineers. (*a*) Sr. supervising test engineer, graduate mechanical, to assume responsibility for planning, co-ordinating results of experimental test program. Experience in internal-power systems, small gas turbines, or advanced propulsion devices, hydraulic-actuated systems or missile fuels. About $12,500. (*b*) Test engineer, graduate, some experience in above field, to assist supervising engineer. $8000–$10,000. (*c*) Supervisor instrumentation engineer, graduate, to instrument the above tests, conduct applied research on advanced instrumentation devices. Experience with strain gages, dynamic-pressure and temperature-sensing equipment, flow measuring, and cryogenic instruments. About $12,500. Eastern Ohio. W-9938.

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

Packaging Engineer, graduate, one to two years' experience in packaging on engineering side rather than design. Open. Company pays fee. New England. W-9937 (*a*).

Vice-President, graduate mechanical or chemical engineer, 40–55, to run all aspects of a wholly owned subsidiary of a growth company. Must know oil, gas, petrochemical industries. $18,000–$25,000. N.Y.C. W-9935.

Chief Mechanical Engineer, ten years' experience in design and layout of heating, ventilating, and air conditioning for industrial and commercial buildings for firm of consulting engineers and architects. $10,000–$12,000. Should be registered engineer. Upstate N. Y. W-9934.

Boiler-Plant Maintenance Engineer, additional experience as industrial engineer, i.e., time study, methods, etc., for small plant manufacturing fabrics, felts, and coatings of plastics. $10,000–$12,000. Northern New England. W-9921.

Plant Industrial Engineer, graduate, five years' minimum experience in the manufacture of light electromechanical products. Will have several junior engineers reporting to him. About $9000. Northern N. J. W-9916.

Manufacturing Manager, 35–45, to take complete charge of manufacturing, production planning and control, material controls, purchasing, manufacturing engineering, and plant maintenance. Must have had manufacturing experience with electronic instrument company doing government work. Must be able to meet production deadline and able to work with union. $16,000–$18,000, plus fringe benefits. Relocation expenses paid. N.Y.C. W-9906.

Mechanical Engineer, graduate, 30–40, familiar with rolling mills and auxiliary equipment. Must have experience with plant maintenance and ability to direct draftsmen in machine design for independent aluminum-production mill. Apply by letter including experience, references, salary requirement. Mid-south. W-9858.

Engineers. (*a*) Quality-control analytical engineer, prefer BS (ME) or college graduate with adequate math and statistical courses. Will conduct statistical studies and analyze results for the improvement of product quality and reliability. (*c*) Application engineer, trainee, BSME, about one year out of college. Three or four months' training in divisional office in Conn. Will make recommendations for new applications and handle engineering problems relevant to existing applications; assist with design of special bearings, to co-ordinate engineering activities between customer, sales, design, and other allied departments. Company manufacturers precision bearings. $6200–$7500, plus cost of living allowance of $75 quarterly. Ohio. W-9737.

Instructor or Assistant Professor, mechanical, interested in teaching, particularly in the design area; some experience in machine design. Open. Midwest. W-9735.

Regional Sales Representatives, graduate mechanical or chemical preferred, for a technical sales and service department, involved in the design, construction, and sales of high and low-pressure and temperature filters for all types of industrial service including petrochemicals, refinery, airport refueling, and other related fields. Salary and expenses. Considerable travel. Territories: East Coast, North Central, South Central, and West Coast areas. Prefer men living in the territory they would cover. Headquarters, East. W-9710.

Director of Product Development, engineering graduate, at least ten years' managerial and administrative experience in design and application of nonferrous metal products. $20,000–$24,000. South. W-9697.

Quality-Control Engineer, preferably graduate mechanical, experienced in manufacturing processes, equipment, and materials, ideally in the heavy metal fabricating industry. Duties will include direction of quality-control analysis activities under direction. Will develop standard quality specifications and inspection procedures, develop quality-control manual, prepare necessary reports. Submit complete résumé including education, experience, and salary requirements. Upstate N. Y. W-9695.

Manufacturing-Program Director, degree in industrial, mechanical engineering, or industrial administration, at least eight to ten years' experience in manufacturing management. Some teaching experience helpful. Must be qualified to create seminar programs and also to conduct these programs. To $11,000. N.Y.C. W-9674.

OBITUARIES

Jerome Gordon Bower (1875–1960), retired sales engineer, Buckeye Steel Casting Co., New York, N. Y., died, Sept. 27, 1960. Born, Waynesburg, Pa., Nov. 26, 1875. Parents, Charles E. and Josephine (Gordon) Bower. Education, ME, Ohio State Univ., 1897. In the steel industry for most of his life, Mr. Bower spent 24 years with the Buckeye Company. He started his career as a special apprentice with the Pennsylvania Railroad Lines Southwest System. In 1902 he was a sales agent with the Pressed Steel Car Co., Chicago, Ill., leaving there in 1911 to become a sales agent for Hale and Kilburn Co., Chicago. Two years later he joined Buckeye Steel Castings Co., as eastern representative, remaining in their employ until his retirement in 1937. Assoc-Mem. ASME, 1903. He was a member of the American Iron and Steel Institute.

Charles Henry Davis (1865–1951), civil engineer, and executive officer of many corporations, died, June 3, 1951, according to a notice recently received by the Society. Born, Montgomery County, Pa., May 4, 1865. Parents, Henry Corbit and Martha (Mellor) Davis. Education, CE, Columbia Univ. School of Mines, 1887; DE, Univ. of Maryland, 1936. Married Helen Maria Hinds (dec.) 1896. Married 2d, Grace Bigelow, 1903. Married 3d, Alice Bancroft, 1931. Mr. Davis was responsible for numerous innovations leading to more efficient transportation and electrification. He was the trustee of many estates and president, treasurer, and director of numerous mining, industrial, and railway corporations. In the field of transportation, he built the first high-speed cross-country trolley line from Alexandria to Mt. Vernon, Va., in 1902; and advocated and issued the first designs for railroad tunnels under the Hudson River. He also designed the first electric signals and controls for fast trains at close headway in use on the New York subway system. He founded the first school of highway engineering at Columbia University in 1911, for which purpose he raised $50,000. In 1892, he used the first concealed lighting in a private New York residence, later that year using it for the first time in a public building, New York's Carnegie Music Hall. Iron pipe conduit interior wiring, later placed in universal use, was initially suggested by him, and "panel board" distribution of light and power, also in use throughout the world, was first designed and installed by him for the Pennsylvania Mutual Life Insurance Building in Philadelphia, in 1902. Mr. Davis acquired his early education in private and public schools in France and the U. S., entering the Towne Scientific School at the University of Pennsylvania when he was 17, and the Columbia University School of Mines one year later. He studied both civil and mining engineering. During the early period of his career, he was variously associated with Thomson-Houston Electric Co., Lynn, Mass.; Sawyer-Man Electric Co., New York, N. Y.; and Westinghouse Electric Mfg. Co., as an engineer, sales manager, and construction manager. Later, from 1889 to 1906, he was a consulting engineer in the cities of New York, Philadelphia, and Boston, and from 1906, the executive officer of many corporations. He was a senior member of Charles Henry Davis and Partners, engineers of New York; president of the American Road Machine Co., Barclay Railroad Co., Long Valley Coal Co., John Stephenson Co., Ltd. (car builders), Miller Oil Co., and Kentenia Corp., among others. After establish-

ing himself as an expert in transportation, he was made honorary chairman of the Institute of Transport, Washington, D. C., an organization for research and education concerning all types of transportation and communication. He also was named honorary president of the Educational Division of the American Road Builders Association, which brought together instructors from the schools of highway engineering in the U. S. and Canada. He was a founder of the American Association of State Highway Officials, and the National County Roads Planning Commission. He also founded the Individual Psychology Foundation in 1927 to assist in organizing advisory councils of teachers, pupils, and parents when the study was in its first stages. As an author, he contributed numerous articles to magazines. Mem. ASME, 1890. He was a member of AAAS and the Society of American Military Engineers.

John Francis Grace (1880–1959), condenser engineer, Worthington Pump and Machinery Corp., Harrison, N. J., died, Jan. 31, 1959. Born, Liverpool, England, Dec. 17, 1880. Parents, Richard Raleigh and Mary A. (Fitzpatrick) Grace. Education, scientific course, Brooklyn, N. Y., Boys' High School. Married Adele Marie Hague, 1913; children, Adele, Jr., Marion, Richard, and Jeanette. Mr. Grace was associated with the Worthington Corp., since 1897, when he started as an apprentice. In 1904, after advancing through various positions as a toolmaker, molding-machine builder, shop foreman, and draftsman, he became a designing engineer. He did experimental testing and inventing on surface and jet condensers and cooling towers, holding 50 patents in the field. Mem. ASME, 1915. He received the Modern Pioneer Award of the National Association of Manufacturers.

Arthur Halliwell (1893–1960), organization and methods examiner, Management Section, U. S. Marine Corp., San Diego, Calif., died, Sept. 24, 1960. Born, Wigan, Lancashire, England, Oct. 11, 1893. Parents, Walter and Elizabeth Halliwell. Education, ICS and John Huntington Polytechnic School. Married Miss Podmore, 1922; children, Barbara Louis and Anne Elizabeth. A specialist in production engineering, Mr. Halliwell worked on time studies and cost reduction with the Warner and Swasey Co., The White Motor Co., The Whitman and Barnes Co., and the General Iron Co., Denver, Colo., before going with the Marine Corp. Previously, he had spent nine years with The Ferro Machine and Foundry Co., and a year with The F. B. Stearns Co., as foreman and superintendent. He held a civil service rating of mechanical engineer. Articles written by him were published in MECHANICAL ENGINEERING and *The Colorado Engineers Bulletin*. Assoc-Mem. ASME, 1924; Mem. ASME, 1935. He was past-chairman of the ASME Program Committee; secretary and chairman of the Colorado Section; and chairman of the 1934 Spring Meeting in Denver, Colo. He was a member of the Society of American Military Engineers, and a registered professional engineer in Colorado.

John Preston Mailler (1890–1960?), retired engineer, died recently according to a notice received by the Society. Born, Cornwall-on-Hudson, N. Y., Sept. 25, 1890. Parents, William H. and Sophia (Preston) Mailler. Education, BS, Rutgers Univ., 1912; ME, 1916. Married Margaret McGregor, 1914; children, Helen, John, William D., and David W. Mr. Mailler specialized in power-plant operation, starting as a test engineer with General Electric Co., Schenectady, N. Y. Thereafter, he was a cadet engineer for three years with the Public Service Electric Co., Newark, N. J., and then an assistant mechanical engineer with the Interborough Rapid Transit Co., in New York City, having charge of operation of the 59th and 74th Street powerhouses. In 1917 he joined the Buffalo, Rochester, and Pittsburgh Railroad in DuBois, Pa., as an electrical engineer in charge of all powerhouses and electrical apparatus. From 1920 to 1944 he was chief engineer with Northeastern Water and Electrical Service Corp., and Electrical Management and Engineering Corp., in New York. Then he became chief engineer with the New Jersey Power and Light Co., in Dover, N. J. Assoc-Mem. ASME, 1919; Mem. ASME, 1935. He was a registered professional engineer in New York and New Jersey.

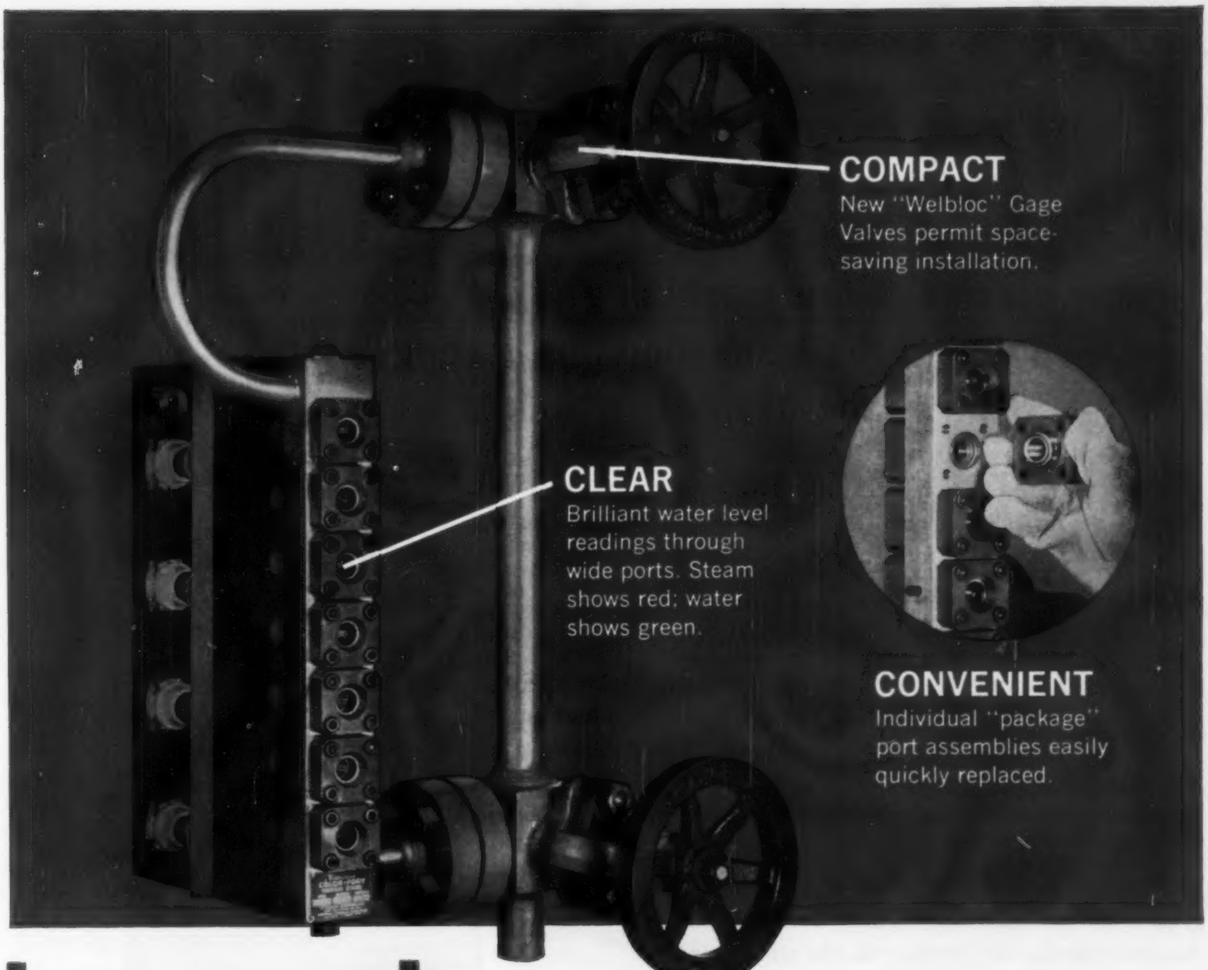
Joseph Wickham Roe (1871–1960), retired professor and chairman, department of industrial engineering, New York Univ., died, Southport, Conn., Nov. 9, 1960. Born, Geneva, N. Y., Oct. 3, 1871. Parents, Alfred C. and Emma (Wickham) Roe. Education, PhB, Sheffield Scientific School, Yale Univ., 1895; ME, 1907. Married Nelley Allen (Dec.), 1902. Married 2d, Mary Sherwood (Lambertson), 1915. Mr. Roe was a pioneer in aviation. After graduating in 1895, he worked as a draftsman, and later became chief draftsman, with Winchester Repeating Arms Co., in New Haven, Conn. In 1898, he went with Henry R. Worthington Hydraulic Works in Brooklyn, N. Y., becoming chief draftsman, and two years later became assistant superintendent of J. H. Williams and Co, Brooklyn, makers of drop forgings. In 1903 he joined the engineering staff of the Crane Co., of Chicago and Bridgeport, Conn., where he was chief draftsman. He taught at Sheffield from 1906 to 1917, when he was commissioned a major in the Aviation Section, Signal Reserve Corps of the Army. In 1919, he became secretary of the Railway Car Manufacturers Association, New York City, and in 1920, executive engineer of the Pierce Arrow Motor Car Co., in Buffalo, N. Y. He joined the N.Y.U. faculty in 1921, where he was professor and chairman of the industrial engineering department until 1937. He retired from his teaching duties in 1938, after a year as visiting professor of management at Yale Univ. Dr. Roe was a delegate to the World Power Conference in London in 1924 and afterward was a member of the committee of the first International Management Congress in Prague, Czechoslovakia. He directed the study of civil aviation made jointly by the Department of Commerce and the American Engineering Council in 1925. During this period he also was consultant to the staff that organized the Museum of Peaceful Arts in New York City. Later this became the Museum of Science and Industry. He was a consulting engineer to the Navy during World War II. He was a protagonist of civil aviation in the dawning era of air travel. His many surveys, some of them made for the Federal government, promoted such facets of the infant industry as safety, cheaper insurance for fliers, and a positive policy of financial encouragement from Congress. He won many awards, both in the U. S. and abroad. In 1924, he was made an honorary member of the Masaryk Academy, and in 1927 Czechoslovakia honored him further with the Cross of Knight of the White Lion. In 1945, he was given the honorary DS degree by Middlebury College in Vermont. Upon his retirement from teaching, he developed his talents as an artist, winning a prize for his first painting in a New York Yale Club amateur show. He authored numerous articles and books, the best known of which is "English and American Tool Builders," published in 1916. Mem. ASME, 1902; Fellow ASME, 1941. The Society awarded him the Melville Medal in 1929. He was a chairman of the ASME Meetings Committee, and did work on the committees on Administration, Relations with Colleges, Publications, and Professional Division. He was a past-president of the Society of Industrial Engineers, and a member of the American Engineering Council, on whose executive board he served, 1922–1923. The Society for the Advancement of Management awarded him its Gilbreth Medal in 1939. He also was a member of Sigma Xi, SPEE, the Institute of Management, and the Newcomen Society (London). He was a registered professional engineer in New York State. Surviving are his stepdaughter, Mrs. George O. Pratt, of Southport, Conn.; two grandsons, George Pratt, Jr., and Sherwood L. Pratt, and two nieces, Mrs. Herbert T. Harris and Mrs. Bennet F. Schauffler.

George Sachs (1896–1960), research professor and associate director, Syracuse University Research Institute, died, Oct. 29, 1960. Born, Moscow, Russia, April 5, 1896. Parents, Siefried and Clara Sachs. Education, BS, Technisch Hochschule, Berlin, Germany, 1920; DS(ME), 1923. Married Liselotte Lehmann, 1924; children, Peter, Maria, and Rainer. Dr. Sachs attained international fame for his work on the fundamentals of the metallic state, and on the mechanical properties of ferrous and nonferrous materials for such items as armor plate, tubes, cartridge cases, aircraft parts, and weld metal. He was cited by the War and Navy Departments for outstanding contributions to the work of the OSRD during World War II. Before coming to the United States in 1936, he participated in metals research with several German agencies, and lectured on the subject in German universities, including Technisch Hochschule in Berlin, and Frankfort-Main Univ. He was assistant to the department of mechanical engineering at the former, from 1921 to 1923. Then he became section head at the Kaiser Wilhelm Institute for Metals Research in Berlin, where he was until 1930, when he took the post of director of metals research at Metallgesellschaft, Frankfort. He also was vice-president of development and research with Duerener Metallwerke, Dueren, Germany, for a year before leaving the country. From 1936 to 1938, after coming to the U. S., he was a department head in the field of electrical contact devices with Baker and Co., Newark, N. J. With Case Institute of Technology, where he was from 1939 to 1948, he became successively, assistant professor, associate professor, professor, and director of metals research. It was during this period that he assisted the aircraft industry as director of NDRC and OPRD projects, for which he was awarded a certificate by the War and Navy Departments. Case Institute also awarded him the Distinguished Army Service Award, in 1944, for development work on cartridge-case fabrication. He was director of the National Metallurgical Laboratory in India, 1948–1949, and then established offices as consulting engineer and president of Metals Research Associates, Cleveland, Ohio. The firm assisted the metallurgical industry in research and development in casting, processing, fabricating, and heat-treating. At that time, Dr. Sachs also acted as a consultant to the National Advisory Committee for Aeronautics. In 1950 he became vice-president of Horizons Inc., Princeton, N. J., experimental research laboratory for private industry. Three years later he joined the Syracuse University Research Institute, and supervised the institute's contract work for the Army and Navy. He received an honorary DE degree from the Bergakademie (School of Mines), Clausthal, West Germany, in 1958. Honors from German societies included the Gauss Medal from the Academy of Technical Sciences, and the Heyn Medal from the German Society of Metals. He authored and coauthored 15 books and more than 200 papers in the metallurgy field, some of which have been reprinted in several languages. The back-reflection x-ray camera was his invention. Mem. ASME, 1943. He did work on the ASME Committees on Plasticity, Fracture Prevention, and Behavior of Pressure-Vessel Material. He directed a research project for the ASME Shell Forging Committee. He was a fellow and corresponding scientific member of the Max Planck Gesellschaft (previously Kaiser Wilhelm Gesellschaft), in Germany. In addition, he was a member of AIME, ASM (which gave him its Gold Medal Award in 1953), Sigma Xi, Tau Beta Pi, the Society for Experimental Stress Analysis, the (English) Institute of Metals, the (German) Ges. R. Metallkunds, and the (French) College International pour l'Etude de Scientif. d. Techn. d. Prod. Mech. He was the 1941 annual lecturer of the Institute of Metals Division of AIME. He was a registered professional engineer in the State of Ohio.

Frank Ernest Saracino (1906–1960), engineering consultant, Mandel Brothers, Inc., Chicago, Ill., died, April 8, 1960. Born, Chicago, July 11, 1906. Parents, Frank and Josephine Saracino. Education, BS, Illinois Institute of Technology, 1932. Married Dorothy Ward, 1933; children, Josephine, Isabel, and Frances. Mr. Saracino began his career in 1926 as a plant engineer with Bowman Dairy Co., Chicago. He held successive positions with S. W. Mendolsohn, Kentucky Oil Coal, as a combustion engineer; with Chicago Aeronautical Engineering Co., as assistant in general airplane design; with Lincoln-Boyle Ice Co., as a refrigerating engineer; and as assistant chief engineer of The Buckingham Building, 1930. Then he returned to the Lincoln-Boyle Ice Co., as an engineer in charge of maintenance and repairs in 15 manufacturing plants. From 1935 to 1937, he was chief engineer for the Pure Oil Building, a 40-story office building in Chicago. He then became a supervising engineer for the Chicago Housing Authority. In this capacity, he was chief engineer and superintendent of maintenance of a federal housing project that accommodated 2000 persons. In 1944 he went with the Buildice Co., Inc., engineers and contractors, as executive engineer; and in 1945 was with the Manistee Salt Works, Manistee, Mich., as plant manager and engineer. Later, he joined Mandel Brothers, Inc., for whom he was consulting engineer and manager of the Mandel-Lear Building, Chicago, at the time of his death. Assoc-Mem. ASME, 1931; Mem. ASME, 1945. He was a member of ASHRAE and AIEE. Surviving are his wife and three daughters.

William R. Wilson (1862–1960?), retired engineer, died recently according to a notice received by the Society. Born, Norfolk, Va., 1862. Education, ME, Stevens Institute of Technology, 1896. Mr. Wilson was with Pencoyd Iron Works upon graduating, and then became an inspector for Edison Electric Illuminating Co., in New York. Later, after a period in the drawing room of Watson-Stillman Co., he went with the Alberger Pump and Condenser Co., becoming secretary, and then vice-president of the firm. Jun. ASME, 1899.

C. Higbie Young (1892–1960), professor-emeritus of mechanical engineering at Cooper Union, died, Columbus Hospital, Nov. 1, 1960. Born, New York, N. Y., Oct. 4, 1892. Parents, George W. and Jeannette Field (Higbie) Young. Education, graduate, Webb Institute of Naval Architecture; BS(ME), New York Univ., 1934. Married Anne James, 1930. Mr. Young, who was known as the "commodore" of Cooper Union boating enthusiasts, was a specialist in marine engineering. He began his long career in 1915, testing boilers and retorts for the Bronx subsidiary of the Consolidated Gas Co. With the Bureau of Construction and Repair at the New York Navy Yard, from 1917 to 1919, he designed gun foundations and worked on gyro stabilizers, and with the American Bureau of Shipping, from 1919 to 1923, surveyed new ship construction and repairs to damaged vessels. The following year he spent surveying damage and estimating the cost of repairs for the U. S. Shipping Board. Then he left the Navy Department for three years to work with the Lanston Monotype Co., as a salesman, and with the Vitreous Enameling and Stamping Co., as plant manager, but returned in 1927 to the Bureau of Construction and Repair in Washington, D. C., where he worked on the design of new ships. He became an engineering drawing instructor at Cooper Union in 1928, an assistant professor in 1935, and then a professor. Mr. Young, who won his first sailboat race at the age of eight, aroused the interest of his students in sailing and guided them in building boats in the basement of the school, in which boats they competed in races in Long Island Sound. Mem. ASME, 1936. Member also, Society of Naval Architects and Marine Engineers, American Society for Engineering Education, and Society for the Advancement of Management. He was a registered professional engineer in New York.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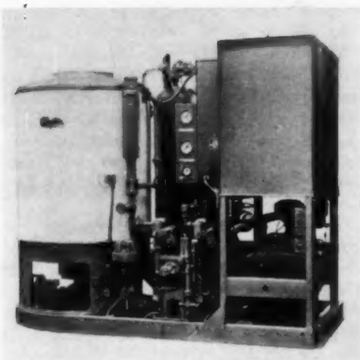


Steam Generator

Manufacture of a self-contained, fully automatic, compact portable steam generator has been announced by Clayton Mfg. Co. The 110-hp oil-fired unit requires only water and fuel supply. Light in weight, it is designed for general industrial use wherever size, weight and non-availability of electrical power are a factor. The unit operates on the forced circulation principle, providing full steam pressure in approximately three minutes from a cold start.

The generator unit contains its own gasoline engine drive to supply power for operation of the generator's electrical controls. No outside electrical power source is required. Also part of the self-contained assembly are a special combination condensate return tank and a chemical water treatment tank. The generator is a 200 psi design pressure unit, model ROM-110.

First of the new units will be installed on a pile driving barge in the Pacific northwest. **—K-1**

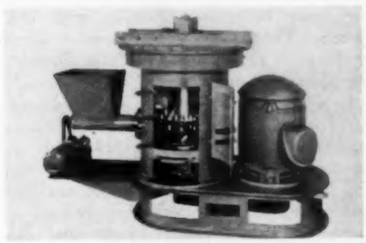
Miniature Compressor

Oil-less motor-powered compressor or vacuum pump, one-twelfth hp, available from Bell & Gossett Co. Suited to industrial, laboratory, and office use for medical equipment, office machines, aeration of liquids, laboratory, small industrial and test equipment. Model LV has 1.9 cfm displacement continuous rating to 27-in. Hg vacuum. Model LC has 1.43 cfm up to 65 psig. Weight 18 lb. **—K-2**

Temperature Regulator

Single-seated, self-contained, diaphragm actuated regulators of the "Eventemp" line have a unique lever-type internal pilot. Pressurized self-cleaning, friction-free Teflon stem seal overcomes problems of faulty regulation. Temperature variations are sensed by a liquid-filled thermoelement which is fully interchangeable while the regulator is on the line.

Cast-iron or bronze bodies, screwed or flanged ends in range of sizes from $^1/_2$ to 4 in. are available for pressures up to 175 psi and temperatures to 500 F. *Sizing and capacity data is available on request from Leslie Co.* **—K-3**



Pulver Mill

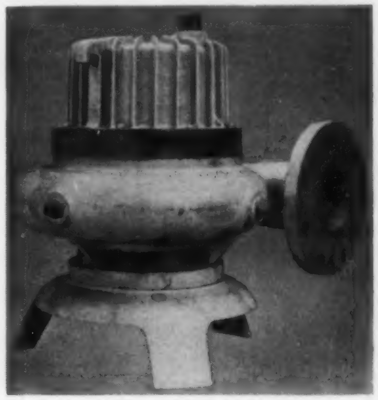
The Sturtevant Mill Co.'s Pulver-Mill, an impact mill with integral air classifier, introduced as a 5000-lb hr unit in May 1959, now is available for small-quantity grinding of soft and medium-hard materials.

The 15-in., 25-hp impact mill is capable of producing in the hundreds-of-pounds-an-hour range, up to a ton and a quarter.

The smaller, up-to-15-CWTs-an-hour impact mill, like the 50 and 150 CWT Pulver Mills, offers patented double-impactor grinding; deflector wall construction to "bounce" partially-ground material back into the grinding zone while further speeding the pulverization process; and adjustable air classification, thus allowing precise end-product selection. **—K-4**

Carbon-Graphite Material

A new grade of Graphitar has greater resistance to oxidation and high temperatures than grades previously available is announced by the U. S. Graphite Co. Grade 2573 can operate up to 1200 F, can be formed into intricate shapes, ground to tolerances of 0.0005-in. Lighter than magnesium, harder than many steels, self lubricating and chemically inert, the material is used for seals, bearings, endplates, valves, liners, bushings. **—K-5**



Non-Clog Submersible Pumps

Non-clog submersible pumps newly announced by Fairbanks, Morse & Co. are especially designed to handle large solids and stringy materials, such as industrial material or wastes, raw or treated sewage, light sludge and slurries.

These compact all-in-one pump and motor units are equipped with a one-piece cast iron impeller either in two-blade design or, where excessive clogging would otherwise be encountered, in the patented bladeless impeller design. The pumps come in 2-in., 3-in., and 4-in. sizes.

The totally enclosed non-ventilated induction motor, available in a range of from $^3/_4$ hp to $7^1/_2$ hp, has an oil-filled interior and finned exterior for rapid cooling in underwater operation. The one-piece motor and pump shaft is Type 316 stainless steel for maximum resistance to corrosion.

Installation in any sump or pit requires only one piping connection and a plug-in electrical connection.

Typical applications of this pump include storm water drainage, small sewage lift stations and general purpose sump drainage. **—K-6**

Precision Dial Indicator

A new super precision dial indicator with accuracy of ± 0.00001 in. has been announced by L. S. Starrett Co.

Starrett No. 25-106 Dial Master dial indicator is designed for applications requiring extreme precision such as shop inspection to laboratory standards or laboratory work. Widely spaced graduations read in 0.00005 in., and the dial reading is 0.0015-0-0.0015, with a total range of 0.003 in. These super precision dial indicators are furnished with jeweled bearings only. **—K-7**

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Quiet Pump

A new, quiet-running Motorpump has been introduced by Ingersoll-Rand Co. The 1750K Line motorpump is designed with a 1750 rpm operating speed to assure extremely quiet operation. The new 1750K Line is particularly suited for air conditioning and heating installations, as an integral part of washing, cleaning, dairy, beverage and water conditioning machinery, where low noise level may be important, and on machine tools.

Models of the new pumps range in output from 15 to 500 gpm with heads to 110 ft. Pumps are equipped with $^3/_4$ hp to $7^1/_2$ hp motors.

The compactly-designed pumps range from $18^3/_8$ in. to $24^3/_4$ in. long, and from $11^3/_{16}$ in. to $15^{11}/_{16}$ in. max width.

The 1750K can be mounted vertically, horizontally, at any angle between the vertical and horizontal, on its side, and in any other position provided the motor is kept higher than the pump. Also illustrated are the positions in which the pump casing may be set to increase efficiency of the flow system. The casing can be rotated to direct discharge in any of four directions, eliminating pipe elbows and angles.

Impeller and shaft sleeve are integral parts of a single casting. Seal materials are matched to pump materials. The seals are mechanical, designed for dripless operation and low power consumption. An auxiliary seal is available for special service such as pumping gritty liquids. Intake and discharge nozzles are cast as integral parts of the casing. No special foundation or bedplate is needed for mounting the pump. **—K-8**

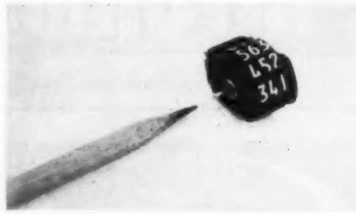
Digital Pressure Transducers

Continuous, accurate, and reliable monitoring of gas and liquid pipe lines through printed records and warning alarms is possible with a new series of digital pressure transducers available from Datex Corp.

Called the DX-100 series, they indicate in digital form the magnitude of pressure inputs. The output of any transducer is suitable for entry into recording devices such as printers, card punches, tape punches, and light banks.

Packaged in a metal enclosure suitable for wall mounting, the typical unit contains an input pressure element, force amplifier, shaft position encoder, motor, power supply, mechanical linkages and terminal strips for electrical connections. An appropriate input pressure element required to span the required range is used. For applications where corrosive gases or liquids are encountered, stainless steel elements are available.

Readout is possible in steps as low as 0.01 psi for low pressures and 0.1, 1, and 10 psi for higher pressures. Ranges available are from 3–15 psig to 0–10,000 psig. Several options, including resetable alarm contracts, are available. **—K-9**



Precision Counters

Improved readability for below eye-level instruments is provided by a new series of precision counters announced by Veeder-Root Inc.

Maximum figure representation results from removal of transfer pinions from an exterior location to within the unit, thus allowing use of larger number wheels. In this new line of compact counters, designated "Series 1736" by the manufacturer, there is a 0.220 in. high figure in a 0.305 in. opening.

Ideal for navigational or directional systems, as well as for laboratory equipment, where largest possible figure size for a given frontal area is required, these new internal pinion units have a static torque of 1.00 oz-in. over a temperature rante of −55 C to 100 C.

Three or four wheels of figures are available on 1736 series, as well as plate extensions with two stationary zeros and decimal point indication. Counters may also be furnished with left wheel stops.

On all units, frame and caps are black anodized aluminum with drive of stainless steel. The drive shaft runs in miniature precision ball bearings, and may be obtained as a left or right extension.

Actual counting is performed by 0–9 unit wheels which register 10 counts per revolution. Speed is 750 rpm intermittent and 300 rpm continuous. Numeral styling conforms to MS33558. **—K-10**

Temperature Indicating Controller

A new double-target temperature indicating-controlling pyrometer, the N-15 Pyrotroller, has been introduced by the Alnor Instrument Co.

The electronic on-off controller provides a second control point for secondary or additional action. For instance, besides controlling temperature, the N-15 Pyrotroller also could independently open and close a valve, or turn a motor or blower on and off.

The attractive, modern instrument case of sturdy die cast aluminum with black enamel finish and satin trim is designed for flush mounting. Only $6^3/_8$ in. × 7 in., it makes a highly desirable panel board instrument.

The controller is available in eleven ranges from 0–400 F to 0–3000 F, as well as an environmental test chamber range of −100 to + 300 F. **—K-11**

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Ultrasonic Cleaner

Lawrence Mfg. Corp.'s Ultracleaner line of sonic energy cleaners has been broadened to include five new sizes with tank capacities up to 10 gal.

The rugged construction of this new equipment is said to allow for continuous use in mass production cleaning as well as single operation soil-removal from electronic, mechanical, optical, and horological parts and assemblies.

Through the scouring action of ultra-high-frequency sound waves, the Ultracleaner is particularly adapted to cleaning of precision mechanism and instruments, complex parts with blind holes, electronic and vacuum tube components, motor and generator parts, printed circuit assemblies, jewelry and the like. It has been especially effective for special plating problems.**—K-12**

Double Acting Cylinders

A line of 10,000-psi heavy-duty, double-acting hydraulic cylinders with choice of stroke length has been announced by Precision Hydraulics Div. of the Owatonna Tool Co.

The new YD series cylinders come in capacities of 50, 75, 100, and 150 tons and have bore sizes: $3^3/_4$ in., $4^1/_2$ in., $5^1/_8$ in. and $6^3/_8$ in. Choice of mounting is offered: tie-rod extensions rod end, head end or both ends.

Construction features are heat-treated alloy steel piston rods ground and polished 10–15 micro finish, heavy wall cylinder shells bored and honed 10–15 micro finish, metallic rod wipers, self-adjusting flange-type rod seals and heat-treated alloy steel tie-rods and nuts.

A range of high-pressure pumps, power packages and accessories is also available.
—K-13

Subminiature Switch

An extremely sensitive subminiature switch described as capable of maintaining a differential travel within 0.001-in. has been announced by Minneapolis-Honeywell's Micro Switch Div.

Despite the close tolerances, neither electrical nor mechanical performance has been sacrificed, the company said. The new switch is designed for temperature or pressure control for military, electronic or instrument applications.

Operating force for the switch is a maximum $3^1/_2$ oz; release force 1 oz max; differential travel 0.001-in. maximum; overtravel 0.003-in. minimum and a 0.008-in. minimum break travel.

Electrical rating is 30 volts with 3 amp inductive, 5 amp resistive and 24-amp maximum inrush. UL listing is 5 amp at 125 or 250 volts ac. **—K-14**

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Canned Self-Priming Pump

A canned self-priming portable pump has been developed by the Corley Co.

The pump, said to be the first of its kind, is self-lubricated and claims the primary features of positive displacement type pumps with the general transfer abilities of centrifugals. It is portable and useful for emptying drums and tanks, particularly if they are filled with corrosives, flammables, toxics or difficult-to-handle fluids. Pump and motor are combined in one compact unit that eliminates seals, drive shafts, couplings, packing glands and bases. It handles up to 11 gpm and temperature ranges from 40 to 180 F. It creates heads up to 55 ft and suction lifts up to 15 ft. It is available in cast iron, bronze, or stainless steel. **—K-15**

Pneumatic Tester

Pneumatic dead weight tester Model 750-A, developed by R. J. Karr Co., is a precise primary pressure standard incorporating a friction-free spherical piston. Application of calibrated weights is the only manipulation required during operation. Inherent self regulation quickly produces a sustained output pressure proportional to weights applied. Critical parts, although essentially immune to fouling, can be cleaned in seconds if required. Resolution, repeatability, and hysteresis are better than 0.005 per cent of output; accuracy 0.05 per cent of output. Pressure ranges up to 61 psi or equivalent in other units. **—K-16**

Data Converter

An all solid state system that extracts data from punched paper tape and writes it on magnetic tape has been developed for business and scientific use by Tally Register Corp.

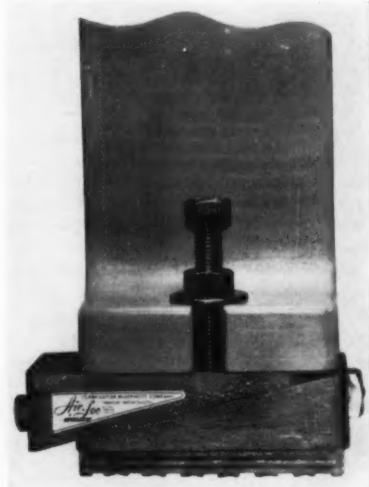
Conversion of data from paper to magnetic tape is accomplished by the new Tally Model 1433 so that input and output data are completely identical in content. No code change is normally performed, with the output record being a bit for bit image of input perforated tape except for format changes as outlined below.

A universal code conversion feature is available at extra cost, with same format controls as basic Model 1433.

The Tally system, Model 1433, will accept paper, foil or plastic tapes in widths varying from 5 through 8 level. It can write data on magnetic tape in formats compatible with IBM 727, 729 Mod 1 and Remington Rand computer inputs.

The system is complete in itself, including a paper tape reader capable of reading 120 characters per second, a magnetic tape handler and necessary electronics for control and tape format.

Tally designed the system to operate from standard power sources and to perform reliably under all environmental conditions normally encountered in a business office. **—K-17**



Machine Mount

Clark-Cutler-McDermott Co. has announced their new Bolt-On Wedgmount. The new Wedgmount supplements their regular line of Wedgemount leveling machinery mounts and Air-Loc machinery mounting pads.

A bolt attaches the mount to any machine. The machine then is equipped with an effective vibration controlling mount and leveling device. The mount becomes an integral part of the machine. **—K-18**

Automatic Valve

A new 12-position automatic valve has been developed by Gelman Instrument Co. This valve can be used for automatic gas sampling and as an automatic sample feed to gas chromatographs or mass spectrographs.

Twelve separate intake ports are connected to a common vacuum chamber. Each valve is sealed by a spring loaded ball valve except at the time the port is open for sampling. A cam controls the opening and closing of each port by moving a rod which unseats the ball. This cam is activated by a Geneva motion coupled to a shaded pole motor. A 3-sec electrical pulse is necessary to move the valve from one position to the next. It takes a total of 10 sec on the standard model for the valve to detent to a new position.

The valve has 12 intake ports and one vacuum port, each tapped for $^1/_8$ in. standard pipe and supplied with hose fittings installed. The valve body is made of corrosive resistant materials.

In a typical application this valve is used in a plant safety program where air from 12 different locations in the plant is connected to one central combustable gas alarm. In this same manner 12 different liquids or different gases can be programmed to flow to one central analyzer or tank. **—K-19**

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Vertical Compressor

New power and new size is offered in the Model WFO air compressor introduced by Gardner-Denver Co.

The WFO is the highest horsepower machine available from Gardner-Denver in the vertical W-type configuration.

This 250-hp compressor operates at 1160 rpm with a piston displacement of 1395 cfm, at maximum pressure of 125 psi.

The WFO water cooled, two-stage compressor has aluminum pistons and high speed valves. Complete compressors are available with Super V-belt drive, built-in motor or direct connected motor. Request Bulletin 1-1V. **—K-20**

Teflon Hose

Now available from Anaconda is Type T4 hose with reusable type fittings that can be made up into assemblies on the job with ordinary hand tools. T4 hose has a core of Teflon, covered with stainless steel wire braiding for added strength and durability. Fittings are cadmium-plated brass NPT males. Available in sizes from $^1/_8$ in. through $1^1/_4$ in. id, the hose conveys steam, fuel, lubricants, hydraulic fluids, air, etc., under conditions of movement and vibration. T4 hose is lightweight, chemically inert and withstands temperatures from −65 F through +450 F. **—K-21**

Particle Size Analyzer

Model PC200A Royco Instruments Inc. particle counter offers a self-contained instrument equally useful for research work as for monitoring the presence and distribution of particulate matter in the atmospheres of such areas as clean rooms for precision manufacture and assembly.

Built in standard 19-in. modular panels integrated into a 31-in. high cabinet, the PC200A presents immediate displays of the numbers of particles present in 15 sub-ranges of sizes from 0.32 microns to 8.0 microns in diameter. Counts appear visually on decade counters, but can be recorded on digital tape or a strip-chart recorder, or both.

Automatic programming is included in the instrument to permit 0.3, 1, 3, or 10 min of monitoring on any selection or all of the sub-ranges in sequence. At the normal flowrate of 100 cc of air per minute, the maximum count rate without excessive coincidence loss is 7340 particles. There is no lower limit for counting; if no particles are present, the instrument will not respond.

Factory calibration is performed using standardized particles and subsequent field calibration is made through circuitry built in for the purpose.

Weighing 220 lb, the PC200A is 24-in. wide, 30 in. deep, and 31-in. high, and draws 515 watts at 115 volts, 60 cps. **—K-22**

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Conveyer Scale

A new conveyer scale which automatically weighs, measures, meters, and controls the flow of bulk materials on conveyer belts has been introduced by Ramsey Engineering Co.

Called the Vey-R-Weigh, it is designed for control applications in any operation where any type of bulk materials is transported on any type of conveyer gallery. The unit is adaptable to many measurements, control and recording operations such as a continuous product inventory, rationing or blending of additives, segregation control, bulk density determination, grade or assay determination or the control of feed rates to processing equipment.

Various types of controls can be provided for remote recording by tape or punch-card readout.

Vey-R-Weigh consists of a conveyer-mounted idler-supported carriage installed to support one idler in the conveyer which weighs the belt and material carried on that idler, and a remote indicating and recording instrument which may be mounted in any location up to 500 ft from the carriage. Adjustments for zero and calibration are contained within the instrument, and a range of full scale capacities from 8.6 to 250 lb per ft of belt is available for standard models. **—K-23**

Silent Pipe

Soundzorber wire reinforced flexible rubber pipe eliminates noise in pipe lines for air conditioning, refrigerating and heating systems. Absorbs pulsations of the liquid column, water hammer. Full faced rubber flanges with steel inserts drilled to 125-lb or 250-lb standards in sizes 4 to 12 in. General Rubber Corp. **—K-24**

Sewage Pump

Rugged cast-bronze construction, newly designed nonclog impeller and volute feature new Model 139. Completely submersible with all controls inside the pump, handles 8600 gph at five-foot head, 6800 gph at ten-foot; drive is one-half hp motor. Kenco Pump Div., American Crucible Products Co. **—K-25**

Check Valve

Cartridge type check valve available in steel or aluminum sizes $^1/_8$-in. to $^3/_4$-in. designed for insertion into a single bored hole avoids bulky piping. Operates at pressures up to 5000 psi. Dead tight sealing and chatter-free operation are claimed by Circle Seal Products Co. **—K-26**

Portable Air Compressor

Powered by a 53-hp 1600-rpm gasoline or diesel engine 125-cfm compressor equipped for automatic operation with dump valve, minimum pressure orifice, low oil pressure cutout. Dry weight of 2190 lb makes unit lightest compressor in its class. LeRoi Div., Westinghouse Air Brake Co. **—K-27**

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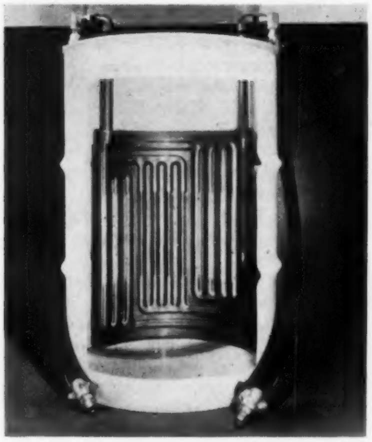

Immersion Drum Warmer

An immersion-type drum warmer, designed for standard 55-gal drums, has been announced by the Platecoil Div., Tranter Mfg., Inc.

The immersion unit, designed for rapid heating of materials in 55-gal drums, consists of a Platecoil heat transfer unit, rolled to the proper diameter to fit the contour of the drum wall. It is available in either serpentine or header construction, with inlet and outlet connections outside of the drum. Although the unit will be available in six different sizes, the 22 in. × 29 in. mild steel size only will be carried as a stock item, with the others available for 3 to 4 week delivery.
—K-28

Speed Reducers, Gearheads

Dynamic Gear Co. has introduced a line of BuOrd Size 11 frame speed reducers and gearheads that feature whole-number ratios, eliminating the need for the design engineer to make extensive, time-consuming calculations. With postless-type construction, the Dynaco speed reducers and gearheads offer ratios that are accurate to within 0.5 per cent. The units, available from stock, are for mounting on standard BuOrd MK 14 servomotors.

The speed reducers and center-shaft gearheads are available in over 190 stock ratios—from 7:1 to 5950:1. One unit is also available in a large fractional ratio of $5^1/_4$:1. Units are either opposite or direct-rotation and lubricated for life (−55 to +100 C) and measure only 1.420 in. over-all.

Mechanical specifications: Output torque, 75 oz-in.; starting torque, 0.005 oz-in.; backlash 30 min max (measured at output shaft under 3 oz-in. reversing torque, moment of inertia at input shaft is 0.02 gm-cm^2). Input, output, and pinion shafts are all made of heat treated Type 416 stainless. Gears are Type 303 stainless. Bearings, shielded throughout, are ABEC-7 and bronze bearings are also available.
—K-29

Abrasive Disks

B14 resinoid bond developed by the Norton Co., for so-called thick disks, and new and improved methods of wheel making have made possible abrasive disks which are uniform from front to back, from one disk to another in an order, and from one order to the next.

Two years of nationwide field tests under actual production conditions have indicated that B14 disks cut faster and cooler and give more pieces per dressing than disks previously adopted as standards for those operations. Jobs ranged from rough grinding of castings to precision grinding with tenths of a thousandth of an inch accuracy.

Materials ground have included steels of all types and hardnesses, gray iron and nonferrous metals; also many nonmetallics such as ceramics and carbons.

The B14 disks are available in a wide range of shapes and sizes with either alum-inum-oxide or silicon-carbide abrasive. They are made with inserted nuts or studs as required for mounting. The disks are available in plain types or with perforations for cool and free cutting if necessary. Disks with radial slots for better coolant distribution are available. Zoned disks (disks with increasing hardness from center to periphery) are made in the larger sizes to maintain more uniform grinding action and disk thickness on work passing between the disks.
—K-30

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Ball Valve

An entirely new concept in ball-valve design is incorporated in the new No. BL-300 forged-naval-bronze valve recently introduced by R-P&C Valve Div. of American Chain & Cable Co.

The BL-300, rated at 300 lb for water, oil or gas service at a maximum temperature of 250 F, available in sizes $^1/_2$ to 2 in. inclusive, has undergone hundreds of thousands of openings and closings without signs of leakage or wear.

Fast and easy to operate since it requires only a quick quarter turn of the handle to open or close compared to several full turns needed to operate a gate or globe valve, the BL-300 is a precision-built valve for general-purpose service costing no more than a high-quality standard bronze gate valve.

The BL-300 has "auto-mating" seats that assure positive sealing in either flow direction and make it ideal for vacuum service. The perfectly machined ball combines with the "auto-mating" seats for smooth positive operation. The wiping action of the ball across the seats forces out foreign matter and thus prevents abrasive wear which causes the average gate or globe valve to leak. The Buna-N seats are impregnated with molybdenum disulphide to give a slippery nongalling surface. Two O-ring stem seals assure a leak-proof stuffing box. The body, cap, stem, disk, and ball are made of naval bronze for maximum strength and safety.
—K-31

Oil-Test Kit

An oil-test kit called Akra-Ez has been developed by the R & W Engineering Co. The kit simplifies oil-testing methods to provide a time-saving and accurate analysis of oil; a complete oil analysis including neutralization number (acidity), viscosity, water content, insoluble contaminents, metal contaminants, and temperatures.

Components include: (*a*) A lightweight carrying case; (*b*) the unique use of magnets for determining viscosity; (*c*) a simple hand-sling-type centrifuge; (*d*) a magnetic detection device for metallic contaminants; (*e*) a simplified titration test for oil acidity; and (*f*) a comprehensive manual which illustrates and explains all procedures and other pertinent information regarding lubricating and power oils.

A complete oil analysis can be made in 12 min. Individual tests for viscosity, acidity, and so forth, can be made in a matter of a very few minutes. The use of the kit requires no technical training. Recommendations for lubricant changes, minimum and maximum temperatures, explanations of the importance of an oil-test program, why oil breaks down, and how to get maximum life from the oil are included in the manual. Special charts provide an easy method of plotting viscosity and neutralization number. The manufacturer claims the proper plot of test results is just as important as the test.
—K-32

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Oil Filter Element

A new lubrication oil filter element claiming a considerable increase in filtration efficiency without a loss in service life has been announced by Caterpillar Tractor Co.

The new element, known as 7M 3800, is a paper element which removes an even greater percentage of impurities than the 9F 6700 element, which it replaces. In addition, it retains the full service life of the earlier unit. Heretofore, according to Caterpillar, an increase in the impurity removing ability of a filter element resulted in a shortening of the service life or recommended element change period.

Outward appearance and dimensions of the new filter element are unchanged, as is the unit cost. The developments making possible the greater degree of impurity removal are found in construction of the filtering paper, which is considerably stronger, thicker and removes more contaminants from the oil than earlier materials.

An additional feature of the new element is "deep grooving" of the filtering paper to maintain proper fold separation. This insures that full filtering area will be maintained throughout the life of the element.

The 7M 3800 element is standard in all track-type tractor and Traxcavator models and motor graders except the D9 manufactured by Caterpillar Tractor Co. in the torque converter, transmission, brake and steering, or crankcase lubrication systems, as well as in these component systems of the No. 583 and No. 572 Pipelayer models. Additionally, it is used in all Caterpillar diesel engines except the D353, D337, and D326. **—K-33**

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Safety-Relief Valves

A new 100-page catalog, No. 301, provides fast easy reference to Crosby-Ashton line of safety-relief and general service valves. Product engineering and performance data, specifications, sizes, service limits and materials of construction are supplemented by capacity chart and tables, a valve service index, details on maintenance equipment, information on special material valves, a guide to corrosion resistance properties of construction materials, excerpts from ASME Codes, pertinent data on ASA flange ratings. Many dimension drawings and tables.

Copy available only by request on Company letterhead directly to *Crosby-Ashton*, 4 Kendrick St., Wrentham, Mass.

Steam-Temperature Control

A new four-page Bulletin 543 describes operation of high-steam-temperature control by Bailey Meter Co. Detailed diagrams explain operation and control principle of desuperheater water control, and burner-tilt and desuperheater water control. **—K-34**

Universal Joints

New catalog on automotive and industrial universal joints, No. J-1960, just published by Mechanics Universal Joint Div. of Borg-Warner Corp. Covers a wide range of general engineering data, descriptive information and complete specifications. **—K-35**

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Door Operator

A new rolling-door power operator made by the Kinnear Mfg. Co. is described in Bulletin 111. Push-button, or hanging control of the electric power unit can be provided. Seven sizes are made with motor capacities to suit all door sizes. A compressible strip causes the door to automatically reverse if it contacts an obstruction, and also serves as a weatherseal. **—K-36**

Power Transmission

Dual torque locking and positioning device described in a 22-page catalog issued by Formsprag Co. Presents a comprehensive application review for REV-LOK two-directional drive unit which can be mounted to transmit driving torque for over-run, backstop, prevent feedback or function in a torque-sensing capacity. Operating principles, functional versatility, installation and maintenance are discussed supplemented by diagrams. **—K-37**

Automatic Steam Generator

A 12-page technical bulletin, No. 586A, describes the Vapor Modulatic, a compact complete steam generator with automatic controls. Steam pressure up to 300 psi from a cold start can be developed in two minutes. Built in safeguards control for low water, flame failure and excessive pressure. Automatic blowdown is optional. Modulatic is job tested at the plant and comes with a Hartford Steam Boiler Inspection Certificate. Vapor Heating Corp. **—K-38**

Drafting Pencils

A comprehensive, 24-page catalog released by J. S. Staedtler, Inc., presents 81 high-quality drafting items. Among them are the new Mars-Lumograph Duralar pencils specially designed for work on drafting film, the Mars-Lumochrom pencils designed for color coding on tracings, non-reproducing pencils for making temporary work notes on drawings, as well as a comprehensive selection of other drafting pencils, leads, and holders. **—K-39**

Horizontal-Force Mount

Bulletin 60-04.14 published by Barry Controls Div., Barry Wright Corp. contains detailed information on Barry horizontal-force mount, Series RM, designed for isolation of shock and vibration produced by machinery whose operation develops predominantly horizontal forces—cold headers, shapers, horizontal compressors, and so forth. It handles up to 4000 lb per mount.

Dimensions product description and technical data on application are included' Typical equipment that can be advantageously supported on this new Barry-mount is listed. **—K-40**

Lathes

Cincinnati Lathe and Tool Co. new Cintimatic numerically controlled lathe is described in an eight-page catalog. Taped commands, read through the Acramatic control console, provide complete automatic control of all machining and operating functions—tool position and feed, tool selection, spindle-speed selection, and coolant flow. General specifications of the all-geared head lathe are included. Setup time is greatly reduced, thus bringing even to short-lot runs the cost savings which are achieved with fully automated equipment. **—K-41**

Barrel-Finishing Machines

A new four-page brochure on the Syntron Co. vibratory barrel-finishing machine has been issued. Specifications and data are given on the company's newer models for deburring, deflashing, grinding, descaling, polishing, burnishing, or drying of unfinished parts. "Before and after" conditions are illustrated. **—K-42**

Controlled-Volume Pumps

A revised 32-page bulletin on motor-driven controlled-volume pumps has been released by Milton Roy Co. This Bulletin No. 553-2, "Motor-Driven Controlled Volume Pumps," features a selection data guide, materials selection charts and capacity-pressure selection tables. Pumps have interchangeable packed or diaphragm liquid ends. They are of the reciprocating, positive displacement type, and are used to meter chemicals in process industry applications. **—K-43**

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Double-Pipe Heat Exchanger

Brown Fintube Co. Bulletin 120 shows correct method of installing conventional and newer types of multi-tube heat exchanger units. Contains helpful hints on installation and cleaning. **—K-44**

Steam Heating Coils

New 24-page booklet gives application information, selection, performance, piping diagrams and installation procedures. Catalog 1710, Dept. T-448, Sturtevant Div., Westinghouse Electric Corp. **—K-45**

Liquid Measure in Pounds

Electric hydrometer described in 16-page booklet available from the Liquidometer Corp. measures directly either density or specific gravity to provide gravimetric correction to liquid flow or tank contents. **—K-46**

Cases and Covers

Custom-built fabricated sheet-metal cases and covers to meet practical needs particularly in the electronics industry are described in a 12-page folder issued by Great Eastern Metal Products Co. Mil-T-27A fabricated cans, brackets, resistance weld screws, mounting studs, and blind inserts are among the products listed. **—K-47**

Duct Liner

The advantages of Micro-Bar dual-density fiber glass duct liner, which has a low fire-hazard rating, in checking air erosion, cutting noise, and improving insulating efficiency are described in an eight-page brochure, published by Johns-Manville.

The new material is a resilient, semirigid blanket-type insulation composed of a strong, very fine inorganic glass fiber bonded by a thermosetting resin to form two different densities of insulation—a tough, heavy density on the surface and a light density underneath. **—K-48**

Graph Sheet Catalog

Graph sheets and their special uses are listed in a new catalog offered by Keuffel & Esser Co. An introductory guide aids in the selection of grid patterns best suited to individual requirements.

Such listings as graph sheets for plotting business statistics, scientific data, sketching and drawing, surveying and mapping, are also included. **—K-49**

Spiral Spacers

Universal-type spiral spacers for use when joining crushable panels to other parts or panels are described in a four-page brochure available from Huck Mfg. Co. The required hand tools are illustrated; and their use in installing a Huck spiral spacer is explained. A tabulation of suggested hole-preparation data is also included. **—K-50**

Indicating Pneumatic Controllers

Bristol's new Series 624 indicating pneumatic controllers are described in a new bulletin. The new A/D (advanced design) control unit is featured. Specifications for the instrument are given, and models are listed for controlling pressure, vacuum, liquid level, flow, temperature, and humidity. Request Bulletin DM058 from the Bristol Co. **—K-51**

Heat-Resistant Alloy

A four-page folder contains engineering data on a new heat-resistant alloy available as static, centrifugal, and shell-molded castings. This new high-temperature alloy has exceptional performance capabilities in the 1800 to 2300-F range. Specifics are presented on physical constants, expansion coefficients, general characteristics, mechanical properties at room temperatures, and high-temperature properties.

Write Electro-Alloys Div., American Brake Shoe Co. **—K-52**

Shaft Rotation Detector

A catalog sheet, on a new unit, that can be used to monitor any points desired in a conveying, handling, or processing system, detects shaft-speed variations as small as 1 rpm. The unit which is electronically controlled with transistors is made by Flo-Tronics, Inc.

There are three standard versions covering shaft speeds from 10 to 40, 40 to 90, and 90 to 150 rpm. Special models can be provided to fit other applications. **—K-53**

Pressure Snubber

A new diaphragm seal-pressure snubber unit for sealed systems, claiming efficient snubbing action with instrument protection against corrosion and plugging, is described in a new brochure released by the manufacturer, Chemiquip Co.

Detailed drawings show how the new device protects plant personnel and instruments if (a) the diaphragm alone should rupture (by preventing flow of corrosive materials into the bourdon tube), and (b) both diaphragm and bourdon tube are ruptured.

Cross-sections of two diaphragm seal housing assemblies are shown, a two-piece for systems using corrosive liquids, and a three-piece for systems with viscous materials or slurries. **—K-54**

D-C Power

Features, operation, and applications for General Electric's custom-built d-c power supplies for computers, aircraft, missiles, military, and special applications are listed in 12-page Bulletin GEA-6690A. Load-current graphs, and a comparison table of relative characteristics of different types of power supplies and power-supply systems are included. **—K-55**

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Binder for Investment Casting

A Monsanto Chemical Co. Inorganic Chemicals Div. technical Bulletin I-199 describes the use of Syton 200 (an aqueous colloidal silica sol) as a versatile and economical binder in the ceramic investment-casting-shell process.

The casting process, industrial ceramic-shell production, foundry procedure, slurry preparation, and stucco applications are covered. Shell-formulation test results, a shell-refractory evaluation guide, and a table showing minimum tensile properties of most common ceramic investment-shell-cast alloys are included. **—K–56**

Spring Mount

Bulletin 60-04.2 is a two-page data sheet on the Spring Mount, Series M, made by Barry Controls, Inc. Designed for high-impact shock and large deflections, it has high isolation efficiency, adjustable damping, sturdy construction, and a built-in leveling adjustment. It can be used to isolate high-precision machinery from external disturbances or heavy-impact machinery from floors. **—K–57**

Liquid Pumps

Bulletin One describes the entire line of liquid material handling equipment manufactured by Blackmer Pump Co.

The new eight-page catalog pictures and describes Blackmer's power driven pumps, variable capacity pumps, proportioning systems, strainers, hand pumps, truck pumps, aluminum transporter pumps, and liquefied gas pumps. It also includes a preliminary selection guide for power pumps, and tells the reader which bulletin provides more details on each product line. Cutaway photographs of pump models and component part drawings in the literature show the many Blackmer features. **—K–58**

Ball Bearing Screws and Splines

Engineering data book available from Actuator Operation, Saginaw Steering Gear Div., General Motors Corp. Basic principles, types, and applications of ball-bearing screws and splines are illustrated and described. Design data, sample problems and information on lubrication, size ranges, critical speeds, and mounting methods are detailed. **—K–59**

Press Brake Dies

Standard and special, single and multiple bend, forming and blanking dies described in new catalog by Press Brake Div. of Valeron Corp. **—K–60**

Submersible Motors

A line of motors for low-head submerged pumping, called U.S. Unimerse Motors, is described in a bulletin, No. F-1976, available from U.S. Electrical Motors Inc. The Unimerse motor is specially designed for drainage of sumps, ditches, tanks, and similar installations and complements the company's established lines of submersible motors for medium and deep-well pumping. **—K–61**

Engineering Index

During 1960 the Index selected and annoted more than 34,000 articles in worldwide literature in twenty languages. Each annotation supplied on a 3 × 5 library card, quickly read and easily filed. Photostats or microfilm of orginal articles available. Request will bring current catalog without charge. **—K–62**

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Here is important news if you design boilers, pressure vessels, or piping systems

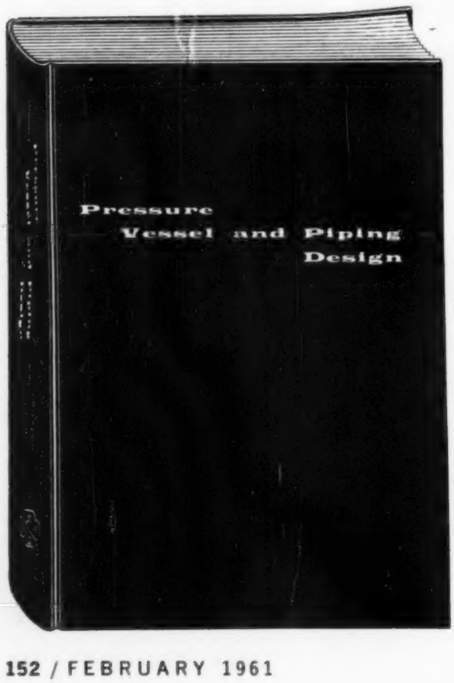
Pressure Vessel and Piping Design

contains articles that have either contributed to the development of the existing ASME Boiler and Pressure Vessel Code and the American Standard Code for Pressure Piping or that you may need to fully evaluate design in many areas not specifically covered by these guides.

A committee of specialists made the selection from the technical papers and reports published in ASME literature and elsewhere between 1927 and 1959.

In all, there are sixty-five contributions covering openings, bolted-flanged joints, heads, shells, piping, materials and fabrication, thermal stress and fatigue, loads and supports, external pressure, and other technical considerations of design.

Photographs, tabular data, charts, and diagrams are used liberally to illustrate and supplement the text.



CONTENTS

OPENINGS: Effect of Openings in Pressure Vessels. Analysis of Experimental Data Regarding Certain Design Features of Pressure Vessels. Reinforcement of Openings in Pressure Vessels. Influence Coefficients for Open-Crown Hemispheres.

BOLTED FLANGED JOINTS: Design of Bolted Flanged Connections. Formulas for Stresses in Bolted Flanged Connections. Analysis of Bolted Joints at High Temperature. Gasket-Loading Constants. Fatigue Tests on Flanged Assemblies. Gaskets and Bolted Joints. Effect of Internal Pressure on Stresses and Strains in Bolted-Flanged Connections. A Design Procedure for Integral Flanges with Tapered Hubs. Stress Conditions in Flanged Joints for Low-Pressure Service. Gaskets for High-Pressure Vessels.

HEADS: Design of Dished and Flanged Pressure Vessel Heads. State of Stress in Full Heads of Pressure Vessels. Stresses at Junction of Cone and Cylinder in Tanks with Cone Bottoms or Ends. Stresses in a Pressure Vessel with a Conical Head. Stresses in a Pressure Vessel with a Flat Head Closure. Report on the Design of Pressure Vessel Heads. Stresses in a Pressure Vessel with a Hemispherical Head. Help in Designing Pressure Vessels. Design of Floating Heads for Heat-Exchangers. Torispherical Shells —A Caution to Designers.

SHELLS: Stresses in Pressure Vessels. Method of Supporting Spheres for the Storage of Liquids. Formulas for the Design of Cylindrical and Spherical Shells to Withstand Uniform Internal Pressure. Formula for Pipe Thickness. Analysis of Stresses in the Conical Elements of Shell Structures. Thick-Walled Pressure Vessels Bursting Pressure of Cylindrical and Spherical Vessels.

PIPING: Stresses and Reactions in Expansion Pipe Bends Data Sheets for Design of Piping. The Significance of, and Suggested Limits for, the Stress in Pipe Lines Due to the Combined Effects of Pressure and Expansion. Fatigue Tests of Welding Elbows and Comparable Double-Mitre Bends. Bending Moments and Leakage at Flanged Joints. High-Pressure (10,300 psi) Piping, Flanged Joints, Fittings and Valves for Coal-Hydrogenation Service. Fatigue Tests of Piping Components. Piping-Flexibility Analysis. Elastic Constants and Coefficients of Thermal Expansion of Piping Materials Proposed for 1954 Code for Pressure Piping. Steam-Piping Design to Minimize Creep Concentrations. Effect of Internal Pressure on Flexibility and Stress-Intensification Factors of Curved Pipe or Welding Elbows.

MATERIALS AND FABRICATION: Strength and Failure of Materials. Heat Treatment of Carbon and Low-Alloy Pressure-Vessel Steels. Elements of Joint Design for Welding.

THERMAL STRESS AND FATIGUE: Thermal Stress. Transient Thermal Stresses in Slabs and Circular Pressure Vessels. Significance of Fatigue Data in Design of Pressure Vessels. Design Values for Thermal Stress in Ductile Materials.

LOADS AND SUPPORTS: Stresses in Large Horizontal Cylindrical Pressure Vessels on Two Saddle Supports. Stresses from Radial Loads in Cylindrical Pressure Vessels. Design of Vertical Pressure Vessels Subjected to Applied Forces Stresses from Radial Loads and External Moments in Cyclindrical Pressure Vessels. Computation of the Stresses from Local Loads in Spherical Pressure Vessels or Pressure Vessel Heads.

EXTERNAL PRESSURE: Strength of Thin Cylindrical Shells Under External Pressure. Collapse by Instability of Thin Cylindrical Shells Under External Pressure. Vessels Under External Pressure. Buckling of Spherical Shells by External Pressure. Allowable Eccentricity of Spherical Heads Convex to Pressure. The New-Type Code Chart for the Design of Vessels Under External Pressure. A Procedure for Determining the Allowable Out-of-Roundness for Vessels Under External Pressure. Stresses in a Pressure Vessel with Circumferential Ring Stiffeners.

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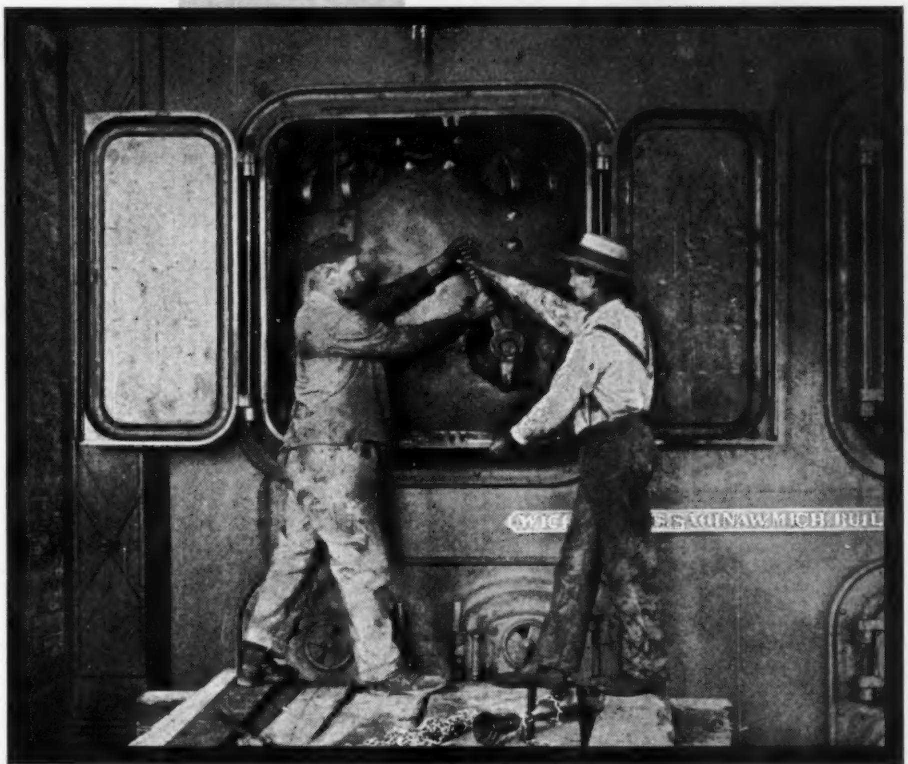

This boiler, built by Wickes Boiler Co. in 1875, operated satisfactorily for the next 31 years.

When buying modern Boiler Equipment it pays to deal with an *EXPERIENCED MANUFACTURER*

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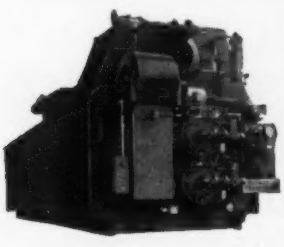

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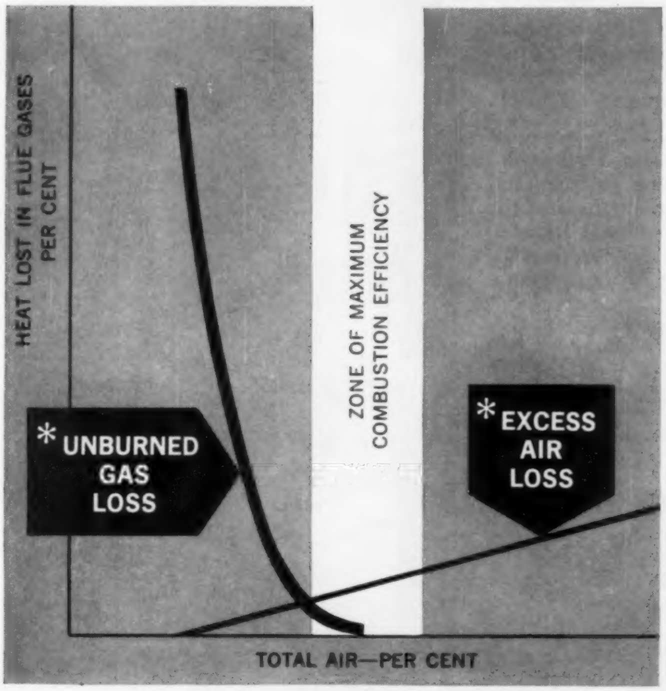

How much money is going up the flue in *unburned fuel* losses? Is too much air resulting in excessive *heat* losses?

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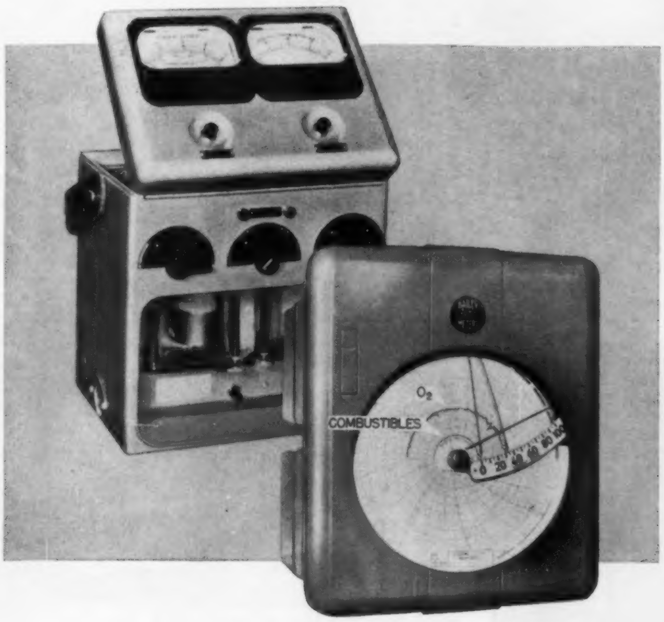

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PORTABLE INDICATOR—Self-contained, lightweight, Bailey HEAT PROVER Analyzer enables quick, easy check on combustion conditions. Dual range dials for greater accuracy and readability.

PERMANENT RECORDER—Bailey Oxygen-Combustibles Analyzer-Recorder coordinates both records on one chart . . . is designed for permanent installation . . . helps maintain optimum ratio continuously.

* Unburned gas loss and excess air loss.

G 155-1

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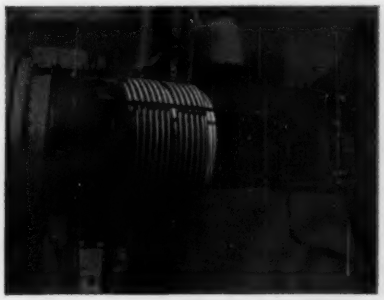
85½ in. dia. expansion joint connecting quench and pre-quench towers. Pinned structural ties permit expansion joint to absorb axial and differential vertical movement.



48 in. dia. expansion joint at compressor discharge. Double bellows permit large axial movement. Internal sleeve guide provides for stability, minimum pressure drop.

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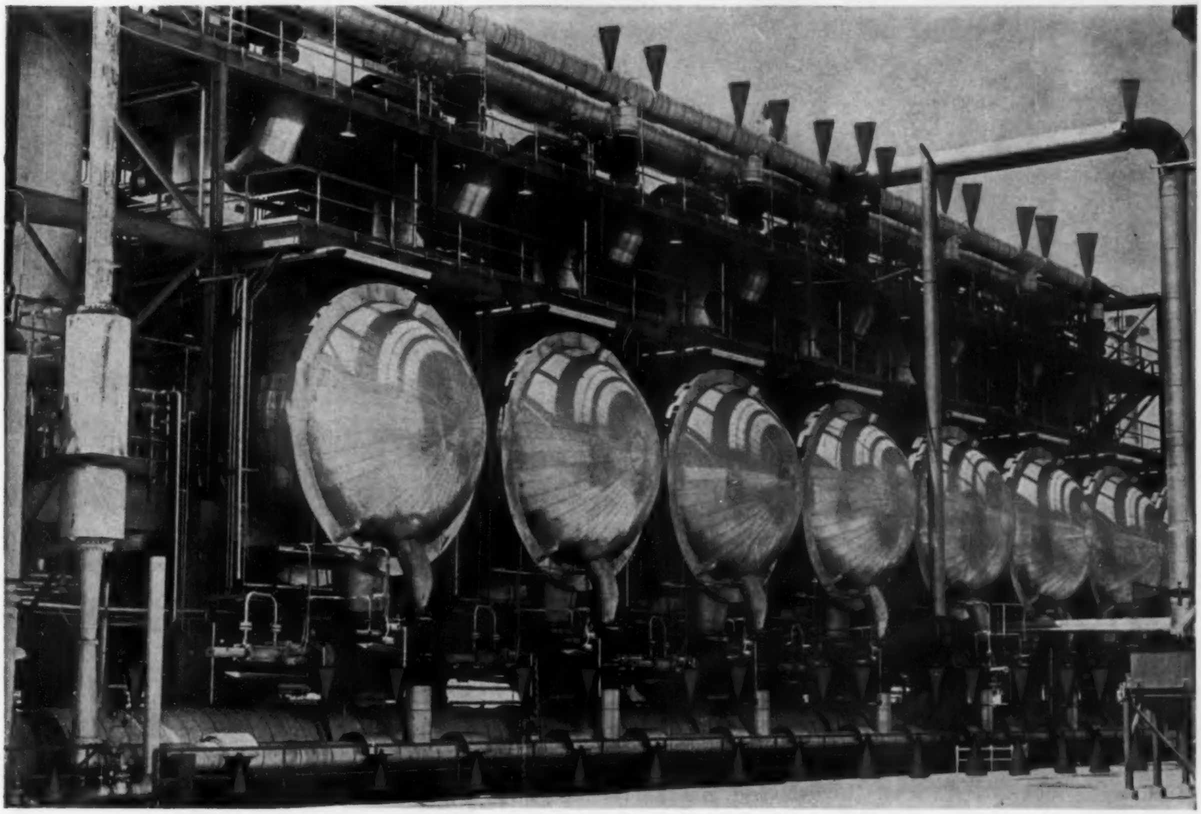

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MECHANICAL ENGINEERING
January, 1961 CARD INDEX Vol. 83, No. 1

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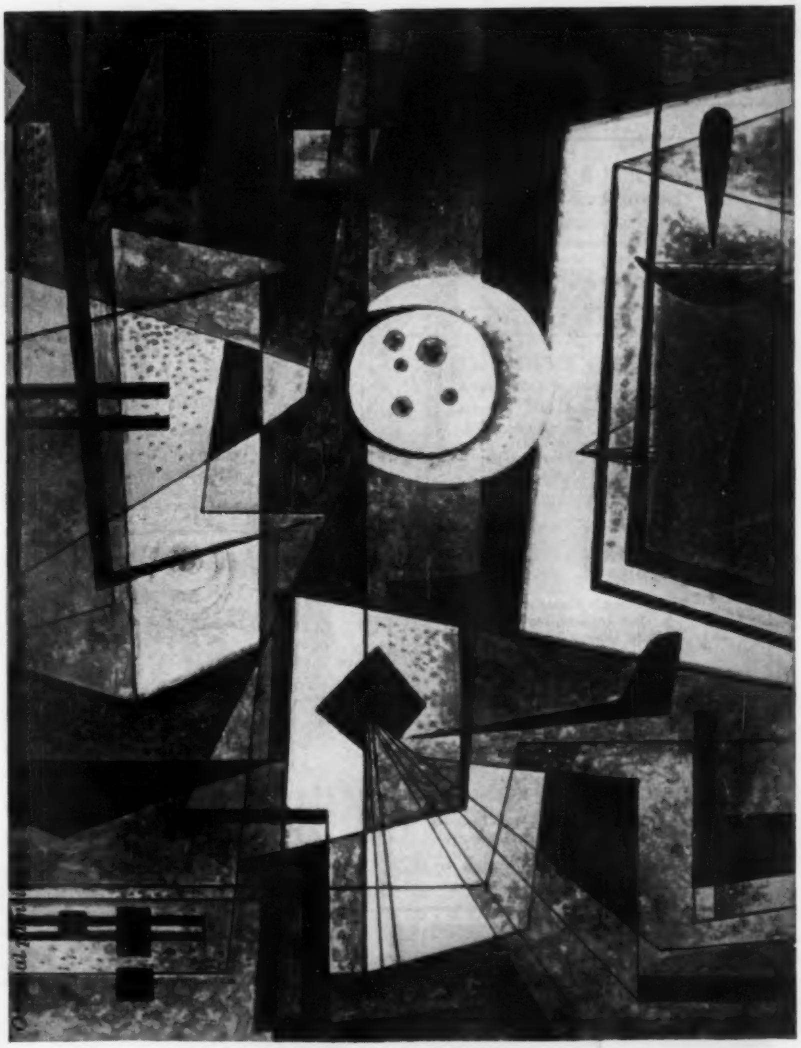

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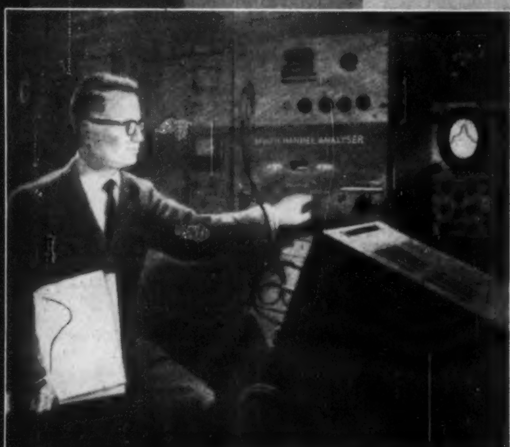

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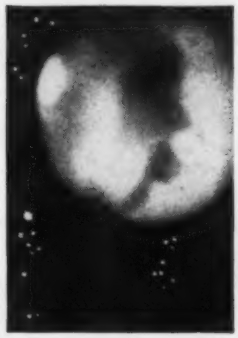

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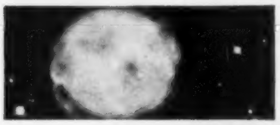
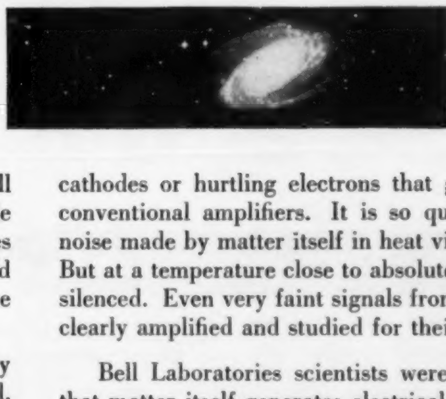


Bell Laboratories research with chilled ruby amplifiers speeds the day we may telephone via satellites



A strange combination of Nature's forces at Bell Laboratories foreshadows the day when world-wide phone calls may be relayed via man-made satellites orbiting the earth. It is a union of synthetic rubies and extreme cold, making it possible to amplify microwave signals from these satellites clearly.

Synthetic rubies possess an extraordinary property when deeply chilled and subjected to a magnetic field. They can be excited to store energy at the frequencies of microwave signals. As a signal passes through an excited ruby, it releases this energy and is thus amplified a thousandfold.

Bell Laboratories scientists chose a ruby amplifier because it's uniquely free of "noises" that interfere with radio signals. For example, it doesn't have the hot cathodes or hurtling electrons that generate noise in conventional amplifiers. It is so quiet that only the noise made by matter itself in heat vibrations remains. But at a temperature close to absolute zero, this also is silenced. Even very faint signals from satellites can be clearly amplified and studied for their possibilities.

Bell Laboratories scientists were first to discover that matter itself generates electrical noise. They also discovered that stars send radio waves, and thus helped found radio astronomy. It is particularly fitting that the same scientists, in their endless research on noise, should now battle this number-one enemy of telephony in the dramatic new field of communication via satellites. The ultimate goal, as always, is the improvement of your Bell System communications services.

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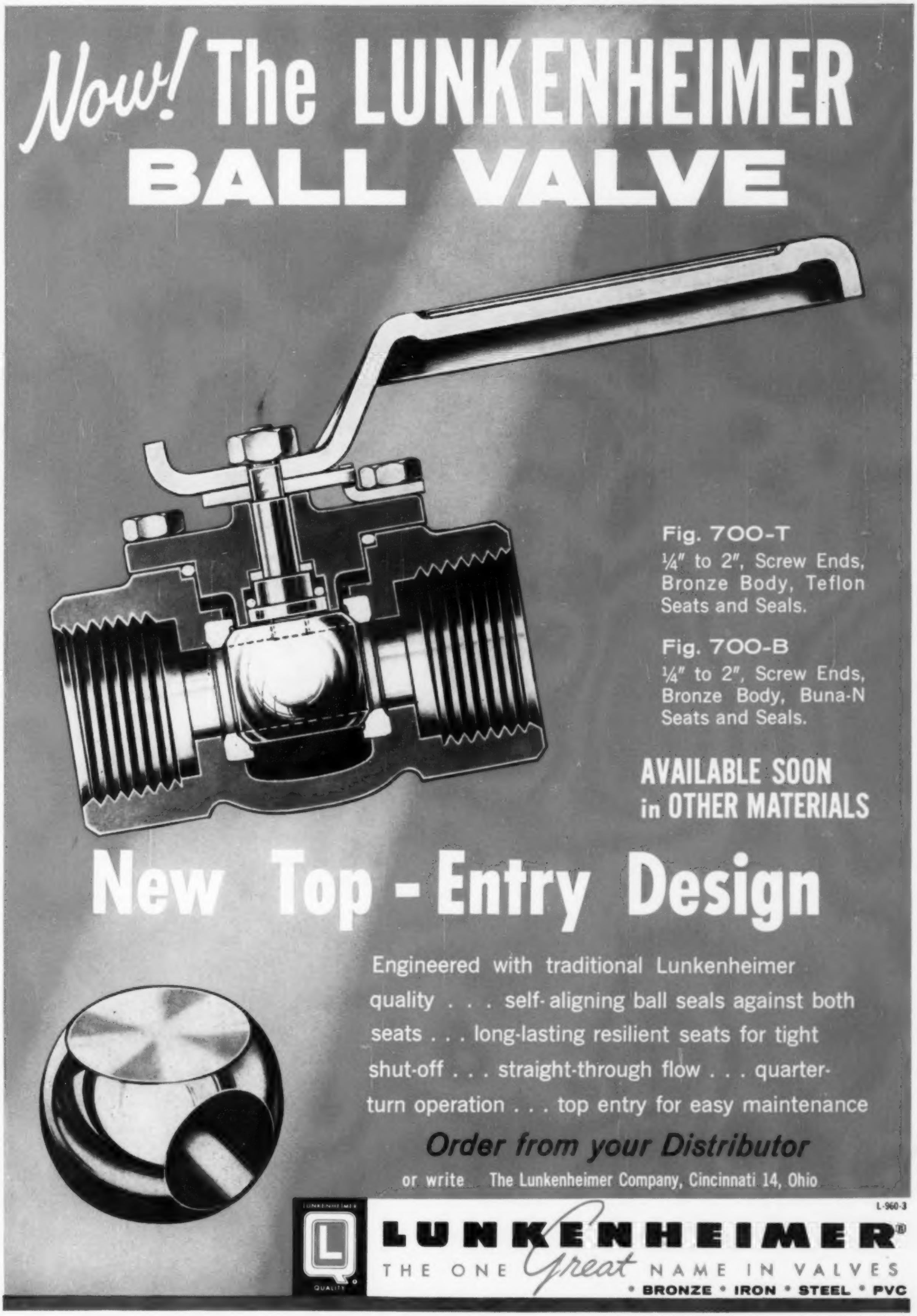
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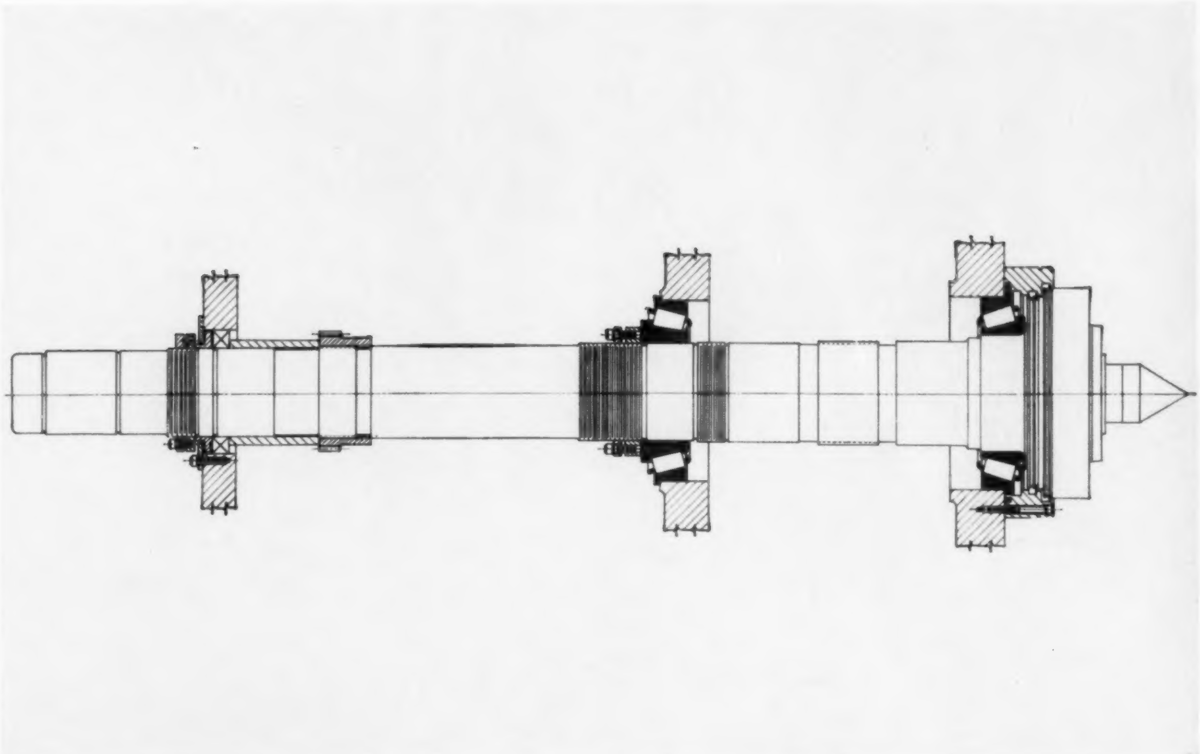
How Monarch assures rigidity, accuracy, with Timken® bearings in "Dyna-Shift" lathe



IN designing their Series 90 Dyna-Shift lathe that can be kept under full load at any speed, Monarch engineers wanted to be sure of rigidity, accuracy and economy. By using 30 Timken® tapered roller bearings at vital points—spindle (shown above), gear box, apron and tailstock—the engineers achieved their objectives. Results from the "90", reports Monarch, show up to 25% more output and 50% greater tool life than with other equipment.

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